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U. S. DEPARTMENT OF AGRICULTURE
DIVISION OF PUBLICATIONS

FARMERS' BULLETINS
Nos. 1001-1025

WITH CONTENTS AND INDEX

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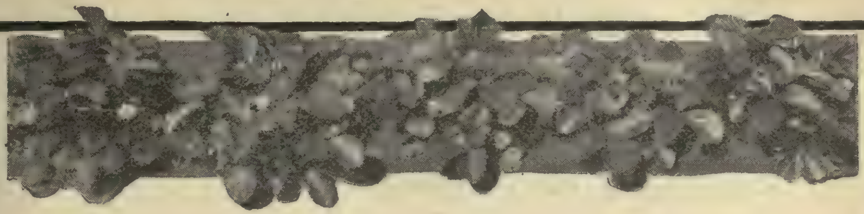
FARMERS' BULLETIN 1001
UNITED STATES DEPARTMENT OF AGRICULTURE



Growing Fruit

for Home Use

WELL-RIPENED sound fruit is healthful. It is also a valuable food. It should form a part of every meal, fresh when possible, or dried, canned, or otherwise preserved.

Home-grown fruit is desirable—

Because it reaches the family fresh and in the best possible condition.

Because the family has fruit of which it would often be deprived if it had to be purchased.

Because, if the proper varieties be selected, a continuous supply of fruit of superior quality may be secured, regardless of market prices.

Because any surplus may be sold without difficulty, or may be canned, evaporated, or otherwise conserved for use when fresh fruit is not available.

Because the care of the home fruit garden provides for spare time congenial and profitable occupation which is in reality recreation for those who enjoy seeing things grow.

This bulletin aims to furnish, in concise form, information that will be of practical help to the beginner in fruit growing.

It deals with the widely grown temperate-climate fruits, such as the apple, pear, peach, and plum. Lists of desirable varieties of these fruits are given for the different parts of the country.

Because of the number of fruits considered and the territory covered, cultural directions are necessarily brief, but they cover the most important general points.

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief
Washington, D. C. February, 1919

GROWING FRUIT FOR HOME USE.

H. P. Gould, *Pomologist*, and George M. Darrow, *Scientific Assistant, Office of Horticultural and Pomological Investigations.*

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WHY THE HOME FRUIT GARDEN.

A MORE general culture of fruits in gardens and in home orchards would contribute substantially to the health and pleasure of the average family, besides furnishing a supply of valuable food products at a relatively small outlay of money.

In many localities the difficulty incident to securing fruit in pleasing variety by purchase is an added reason for its home production wherever possible.

A sufficient range in variety of fruits can be produced throughout a large portion of the country to provide a supply in the fresh state for the table during a large part of the year and for canning or otherwise conserving for use when desired.

This bulletin deals with those widely grown fruits, such as the apple, peach, pear, and plum, which are commonly called deciduous. These fruits, with few exceptions, are borne on plants which shed their leaves annually and must be dormant for a period during each year in order to thrive. They become dormant in most cases through the influence of low temperatures.

THE POINT OF VIEW.

The commercial grower thinks and operates in terms of his orchard, carload shipments of fruit, and market prices. The one who grows fruit for home use thinks in terms of individual trees or plants and works to secure a supply for family use. The commercial grower measures his success principally by the effect on his bank account; the one who grows fruit for home use, by the regularity and quality of the supply that comes to his table and the satisfaction derived from having it fresh and tree ripened and the product of his own efforts.

The ideal fruit garden or home orchard should contain several different kinds of fruit, represented in many cases by a considerable number of varieties ripening one after another over a long period. Large yields, good shipping quality, and attractiveness in appearance may be made secondary to high dessert quality or special excellence for cooking purposes.

THE PLAN.

The home fruit plat should be planned carefully and, in general, with a view to supplying fruit continuously throughout the year either in the fresh state or canned or otherwise conserved. Throughout a large part of the country one may grow in the same garden, if he so desires, the following fruits: Apples, pears, peaches, plums, cherries, quinces, strawberries, raspberries, blackberries, dewberries, currants, gooseberries, and grapes. In the colder sections the winters are too severe for peaches and also for some of the other fruits named unless they are protected; while in the warmer parts apples, currants, gooseberries, and certain varieties of several of the other fruits fail because they are not adapted to the long hot summers and mild winters. But in these warmer regions, Japanese persimmons succeed, and in some of them figs and certain other fruits can be planted successfully. Therefore, one of the most important features of the plan for the

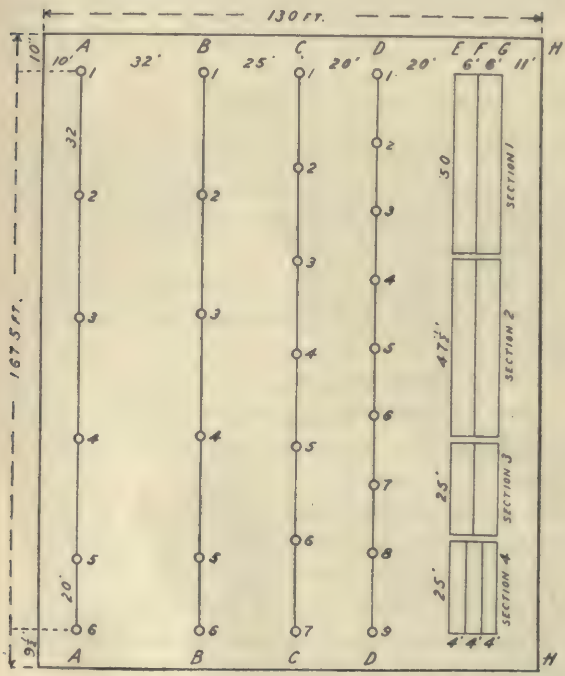

FIG. 1.—Suggested arrangement for a half-acre fruit garden. (See text for details.)

home fruit plantation is the selection of kinds of fruits and varieties of those kinds which will do well in the given locality and which will serve best the purpose for which they are desired.

The diagram shown in figure 1 may be helpful to the prospective amateur fruit grower in planning the arrangement of the ground he is to use for fruits. It represents a half acre of land divided with a view to planting at specified distances apart a given number of different kinds of trees and other fruit-bearing plants, including also a border wide enough to prevent the undue encroachment of the trees on adjacent land.

The fruits provided for in the diagram (fig. 1), by rows, are as follows:

Rows A and B: Nos. 1 to 5, apples; No. 6, apricots.
Row C: Nos. 1 to 3, pears; Nos. 4 and 5, sour cherries; Nos. 6 and 7, sweet cherries.
Row D: Nos. 1 to 5, peaches; Nos. 6 to 9, plums.
Rows E, F. and G: Section 1, raspberries (three varieties); section 2, blackberries (two varieties) and dewberries (one variety); section 3, currants (two varieties) and gooseberries (one variety); section 4, strawberries (four varieties).
Row H: Grapevines, to be trained on a wire trellis, which serves also as a fence.

Quince trees are not specially provided for in this plan; but since they require only a small amount of space and not more than one or two would be needed as a rule, they could be planted between the apple trees or otherwise placed. In the colder parts of the country quinces might well be substituted for the apricots suggested for No. 6 in rows A and B.

It is not assumed that this plan will fit the exact conditions in any particular case, but it shows the possibilities of obtaining a large variety of fruits from a small area of land.

Though not indicated in the diagram (fig. 1), it is possible to plant between apple trees when set 22 feet apart smaller growing trees, such as the peach or plum, placing one between each two trees in the row as well as planting a row in the center of the spaces between the tree rows. This is a temporary arrangement, however, since the apple trees will eventually need all the space. Before crowding begins the interplanted trees should be removed.

Currants and gooseberries commonly do better, especially in the southern limits of their range, if grown where there is partial shade. This sometimes can be provided by planting them between fruit trees. Raspberries and blackberries are sometimes planted between trees, but the practice is not advised unless the soil is naturally moist and fertile.

Vegetables may also be grown between the trees while the latter are small and do not shade the ground very much. Some of the early-maturing vegetables may even be grown between rows of strawberries during their first season. A row or two of strawberries may be planted in the middle of the space between two rows of trees and continued for a time.

THE SITE.

The location of the land on which the fruits are planted, other things being equal, should be convenient to the house. It should be well drained, since fruit trees can not thrive in poorly drained soil. The air drainage also must be good. Cold air settles to the lowest levels, and if a site is so located that cold air settles over it from some surrounding higher elevation, the fruit blossoms are likely to be killed by untimely spring frosts or the fruit may be injured by freezes in the autumn when sites located on the sides of slopes or at points which are higher than the surrounding area escape such injury.

Where the surface of the land is much broken and characterized by high hills, the farm buildings commonly occupy the higher points. In such instances the natural site for the fruit garden or home orchard is near the house, where both soil and air drainage usually are adequate. In other cases the buildings occupy low sites, which are likely to be frosty, and it would be better to plant the family orchard on higher land.

Most fruits can be grown on a great variety of soils, but where possible it is better to avoid light sandy soils and heavy clays. The latter are often difficult to manage in the intensive way necessary for the best success with fruit, while the very light soils are likely to be affected by the various extremes of heat, cold, and drought.

The character of the subsoil is perhaps of greater importance than that of the surface soil. In many instances fruit trees planted where the surface soil appeared to be suitable have failed because of hardpan or rock a few inches or perhaps even 2 or 3 feet below the surface, which prevented a deep penetration of the roots and also made a very shallow and insufficient moisture reservoir. A very coarse gravelly subsoil is little better so far as its effect on tree growth is concerned. A deep subsoil which is friable and porous enough to permit a ready penetration of the roots and a free movement of soil moisture is desirable.

OBTAINING NURSERY STOCK.

Good nursery stock of suitable kinds and varieties is fundamental to success in fruit growing. The average small planter is not in direct touch with nurserymen. He is more often visited by a traveling "fruit-tree agent," who may or may not represent a reputable nursery, and who may or may not know the merits of different varieties and their adaptability to different conditions and regions. Instead of the planter, who should know what he wants and should place his order accordingly, the agent too often selects the kinds and varieties. Not infrequently a tree agent's visit brings the first suggestion that some fruit trees may be planted, and then the grower perhaps is induced to include in the order which he gives the agent some high-priced novelties whose value is uncertain and whose adaptability to the conditions where they are to be planted is entirely unknown.

While many of the long-established nurseries sell their stock largely through agents whose integrity is unquestioned, many other nurseries have no traveling agents, but sell direct to purchasers. It is better, as a rule, for a grower to deal directly with a nurseryman rather than through an agent.

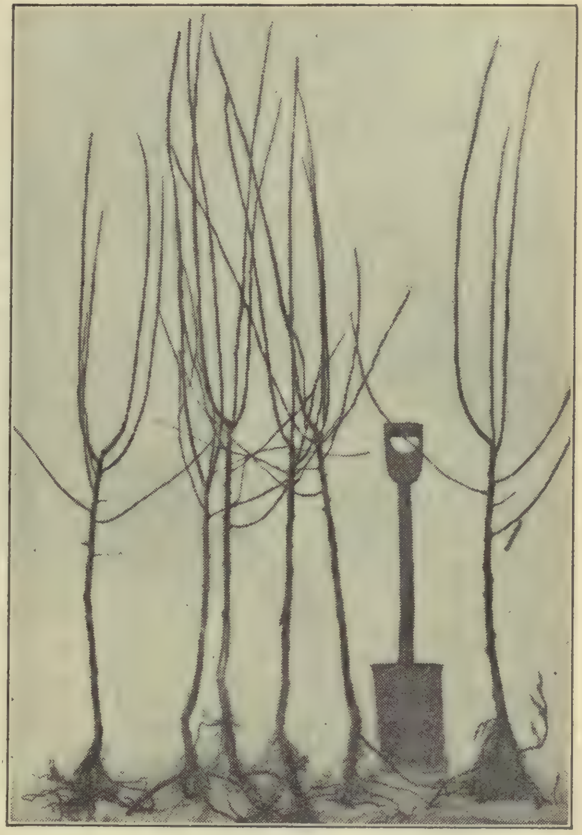

FIG. 2.—Well-grown 2-year-old Stayman Winesap apple trees as received from the nursery.

In selecting varieties a prospective planter should avail himself of the suggestions of experienced fruit growers in his community, the experiment station or the extension division of the college of agriculture in his own State, or the United States Department of Agriculture.

It is difficult to describe good nursery stock. A good root system is essential. A tree or bush, as a rule, should have several main roots and many smaller ones when received from the nursery. A large mass of very small hairlike roots which radiate from a common point suggest a disease called hairy-root; wartlike growths on the larger roots or on the main stem just below the surface of the ground indicate crown-gall. In either case the affected plant should be destroyed. Good grades of several different kinds of fruit trees as received from the nursery are shown in figures 2 to 6.

A plant or tree of medium size for the variety, if of suitable age, is usually preferable to a very large one. On the other hand, plants that are undersized are likely to have been stunted because of unfavorable conditions in the nursery, and not infrequently they prove very expensive in the end, even though the first cost is a little less than that of a better grade.

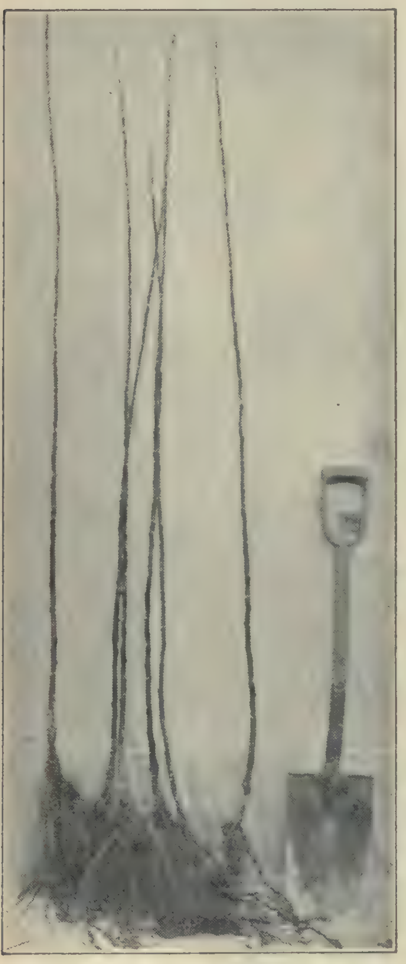

FIG. 3.—Well-grown 1-year-old Stayman Winesap apple trees as received from the nursery. Branching occurs in the second year's growth, as shown by figure 2.

Other things being equal, it is well to purchase the stock from the nearest nursery. The characteristics of a variety with reference to hardiness, vigor, and adaptability to conditions are inherent and are not dependent upon any particular locality for their perpetuation.

Most deciduous fruit trees are planted as 2-year-olds; that is, after they have grown in the nursery for two seasons. This applies specifically to apples, pears, quinces, plums, and cherries. Peach trees are habitually planted after growing in the nursery one season. The practice among orchardists of planting apple and cherry trees when only 1 year old is becoming more common.

In setting out raspberries, blackberries, dewberries, and strawberries, young plants which grew the preceding season are generally used except when they are handled in the autumn. In that case plants of the current season's growth are used.

DWARF TREES.

The practice of using dwarf instead of the ordinary standard trees is more or less prevalent among prospective planters of small areas.

Dwarf trees are produced by propagating them on certain stocks or roots which because of their inherently restricted habit of growth restrict also the size of the tops that have been grafted or budded on them.

While earliness of bearing and exceptionally high quality of the product are often claimed for dwarf trees, some of the best experience in this country has failed to substantiate the latter claim. Dwarf apple and pear trees have their place, however, in the garden or yard, especially under intensive methods of culture, where the space is too small to admit readily of the development of standard trees.

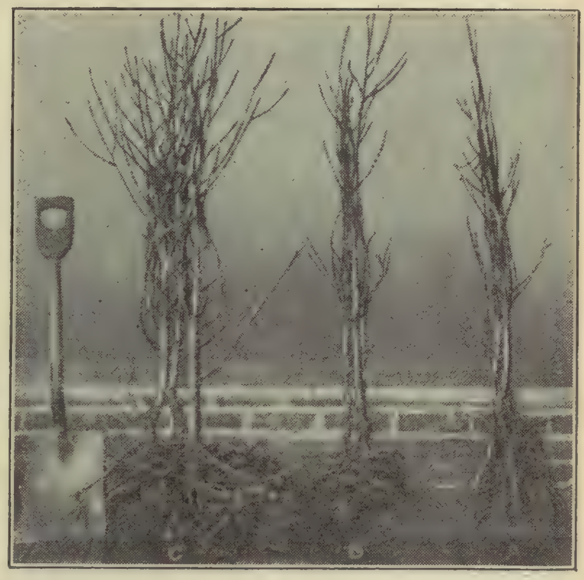

FIG. 4.—Nursery stock, showing different grades or sizes of 1-year-old peach trees: *A*, 3 to 4 foot grade; *B*, 4 to 5 foot grade; *C*, 5 to 7 foot grade.

SEASON OF PLANTING.

In the North and wherever the winter conditions are severe on plant life, either from low temperatures, drying winds, or other causes, fruits are usually planted in the spring as early as the soil can be put in suitable condition. It is very important that they be set out while the plants are perfectly dormant and before the buds have started. Many failures result from delaying the planting until the buds have started into growth.

In middle latitudes and in the South, where winter conditions are favorable, planting in the autumn, after well-matured nursery stock can be obtained, is widely practiced and is usually preferable to spring planting. In some parts of the South planting may be done at almost any time during the winter.

PREPARATION OF THE SOIL.

If the prospective planter prepares the soil where his fruits are to stand as thoroughly as he should prepare his garden before planting vegetable seeds, the subsequent growth of his fruit trees will amply repay him. Where the site selected is in sod, it is advisable to cultivate it during one season at least after the sod is plowed under, in order that the grass roots may decay before the fruits are planted. White grubs, which often infest sod land, are not so likely to be troublesome after the land has been cultivated for one season, especially if used for beans, peas, or some other crop not much attacked by this insect. Freeing the soil from white grubs is particularly important where strawberries are to be planted.

Sometimes the places selected for trees are in a yard which the owner desires to retain as a lawn. In this case the best course is to spade up the soil deeply over an area of several square feet where each tree is to stand. This plan, however, is a compromise between a lawn and a fruit garden, and the results are likely to be more or less unsatisfactory from either standpoint unless special pains are taken to maintain both soil fertility and moisture. The peach is less desirable as a lawn tree than the apple, the cherry, or the pear.

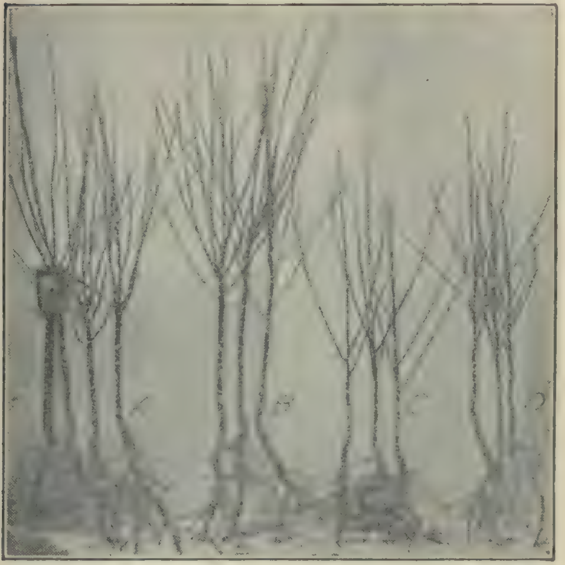
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FIG. 5.—Sour-cherry trees representing different grades of nursery stock, as follows: *A*, 2-year-old Large Montmorency on mazzard stocks, three-fourths inch grade, 5 to 7 feet; *B*, same as *A* except that the trees are on mahaleb stocks; *C*, 1-year-old Montmorency on mazzard stocks, five-eighths to eleven-sixteenths inch grade, 3 to 4 feet; *D*, 1-year-old Large Montmorency on mahaleb stocks.

HANDLING THE STOCK FROM THE NURSERY.

Many of the trees and berry plants set out in the home orchard and garden fail to grow because they are not properly handled.

Every possible precaution should be taken from the time the trees and other plants are dug from the nursery until they are planted to prevent the roots from becoming dry. If the plants are to be set out at once on being received, almost any temporary means of protecting the roots so that they will not become dry will suffice. Wet gunny sacks, an old horse blanket, or some other material that has been thoroughly moistened will serve the purpose. If it is necessary to delay planting for any considerable time, the trees should be heeled in. This operation is illustrated in figure 7. A trench is opened of sufficient size to receive the roots. If the trees are tied in bundles, they should be loosened and the roots separated when they are placed in the trench so that the soil can be worked in among them readily, packed rather firmly, thus excluding the air, and, finally, enough soil should be heaped over the roots to prevent drying out. In this way the stock can be held in good condition for any reasonable length of time, but the planting should be done before the buds start into growth.

PLANTING.

Before the planting operation actually begins, the exact spots to be occupied by the individual trees or the rows where the small-fruit plants are to stand should be designated. The distances between most of the various kinds of fruit trees are shown in figure 1.

Apricots may be planted the same distance apart as peach trees; Japanese persimmons and figs also are planted about the same distance apart, or a little nearer together, though in California the larger growing varieties of figs should be spaced about the same as apples. Quinces, being smaller, may be planted about 14 to 16 feet apart.

The distance between the rows of bush fruits is also shown in figure 1. The spacing of the plants in the rows should be, in general, about as follows: Blackberries and raspberries, 3 feet; dewberries, currants, and gooseberries, 4 feet. Strawberries should be set in rows 3 to 4 feet apart, and the plants 12 to 24 inches in the row. Grapes should be 8 to 10 feet apart each way.

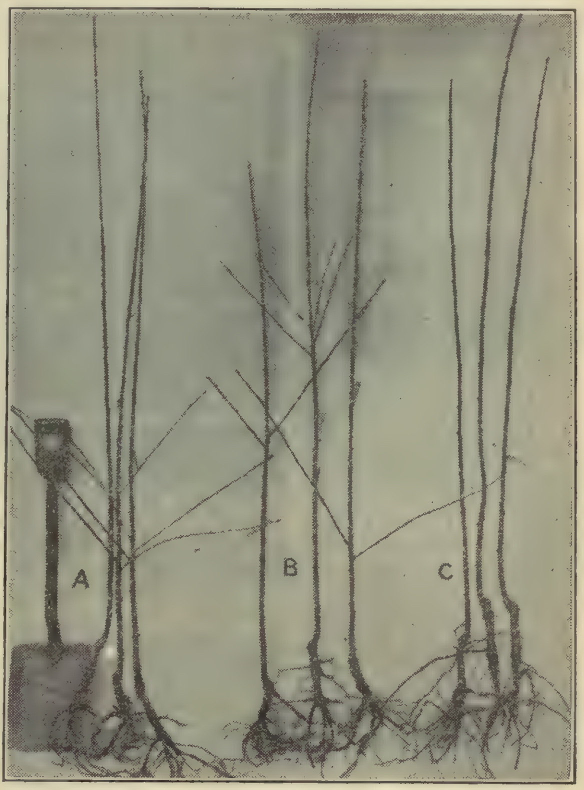

FIG. 6.—Sweet-cherry nursery stock: *A*, 1-year-old Windsor trees on mahaleb stocks, five-eighths to eleven-sixteenths inch grade (the branching is characteristic of this variety); *B*, same as *A* except that the trees are on mazzard stocks; *C*, 1-year-old Schmidt trees on mahaleb stocks, five-eighths to eleven-sixteenths inch grade.

If trees are to be planted in a yard or along a fence where it is impracticable to plow and cultivate the land, due care should be exercised in placing them properly. The relation which the trees will have to adjacent buildings or to the landscape when they attain considerable size should be carefully studied in order to avoid irreparable mistakes in relating the trees to their surroundings.

Locate the first row at the desired distance from the base. This may be half the distance between rows or closer, according to circumstances. (Fig. 1.) Drive stakes where the trees are to stand, and line off the next rows in the same manner till the whole plat is staked out. In planting the trees, use a planting board, as shown in figure 8.

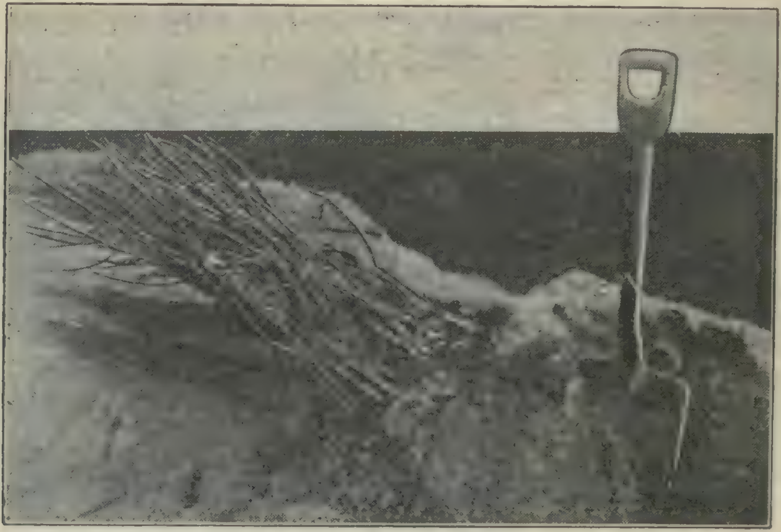

FIG. 7.—Peach trees heeled in. They may be held in good condition in this manner for some time, but should be planted as soon as possible.

The trees should stand an inch or two deeper when planted than they stood in the nursery, and the holes should be broad enough to receive the roots without bending them from their natural positions. This applies also to raspberry, blackberry, currant, and other small-fruit plants with the exception of strawberries. The last should be planted at such a depth that the crown of the plant is even with the surface. If they are planted deeper than this they are likely to smother, while if planted more shallow the roots are likely to dry out.

Under some conditions in planting small fruits it is convenient to open a furrow with a plow along the lines which mark the location of the rows. By doing this the work required in making the holes for individual plants is considerably lessened, although in the home fruit plantation it usually will be more convenient to dig a hole for each plant.

The broken ends of roots should be cut off and any long slender roots should be shortened to correspond to the main root system.

Small-fruit plants should be treated in about the same way, though in actual practice little attention is given to trimming the roots before the plants are set out.

In filling the holes after the trees are placed in position care should be taken to work finely pulverized fertile soil among the roots. This can be done with the fingers better than in almost any other way. After a few shovelfuls of soil have been placed about the roots, it helps if the tree is slightly raised and lowered once or twice. This will tend to work the fine soil in among the roots. As the filling progresses the soil should be firmed about the roots with the foot or in some other effective way. Of all the operations connected with planting, the firming of the soil about the roots is perhaps the most important, and it should be done with great thoroughness. Finally, the holes should be filled even with the surface.

In connection with the planting or immediately following it, the branches of fruit trees should be cut back with a view to giving a desirable form to the top as it develops subsequently. The details of shaping the tops of different kinds of trees at the time they are planted are shown in figures 9 to 12.

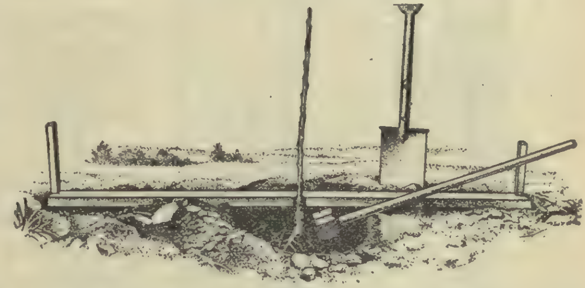

FIG. 8.—Using a planting board in setting a tree. The board has been put in place with the center stake where the tree is shown. It has been taken up and the hole dug; then the board has been returned to its former position, as indicated by the end stakes (which have not been moved). The tree is in the position of the center stake. The tool at the right of the tree is for tamping the soil about the roots.

Sometimes when trees are planted in autumn, the branches are cut back to some extent at that time, but the final pruning is deferred until the following spring.

In planting raspberries, blackberries, currants, and gooseberries, the tops should be cut back to a height of about 6 inches. If currants and gooseberries have particularly strong root systems, the tops are sometimes left 10 to 12 inches high.

CULTURAL METHODS.

Where the fruit plantation occupies a garden site, usually it should receive about the same tillage that is given a vegetable plat. In the popular mind this represents a high standard of excellence. Frequent tillage to maintain the surface soil in the condition of a fine dust mulch is preferable in most cases to any other method of treatment. The tillage of fruit trees should be continued until midsummer in the North, but it may be kept up to good advantage somewhat later in the South. Strawberries, as a rule, should be cultivated until the approach of cold weather.

Under some conditions the owner may prefer to have his trees in sod. Where the soil is well supplied with humus and the moisture conditions are favorable, this practice may not be impracticable; in fact, a "sod mulch" sometimes gives very excellent results. However, it is usually advisable to cut the grass several times during the season and permit it to remain on the surface of the ground as a mulch; this serves in part the same purpose as a dust mulch which is maintained by cultivation. This should be the usual practice when trees are planted in a yard or along the borders of a lawn. In addition, the soil should be kept well spaded about the trees within a radius of 2 or 3 feet of the trunks. This is especially important during the first few years after planting.

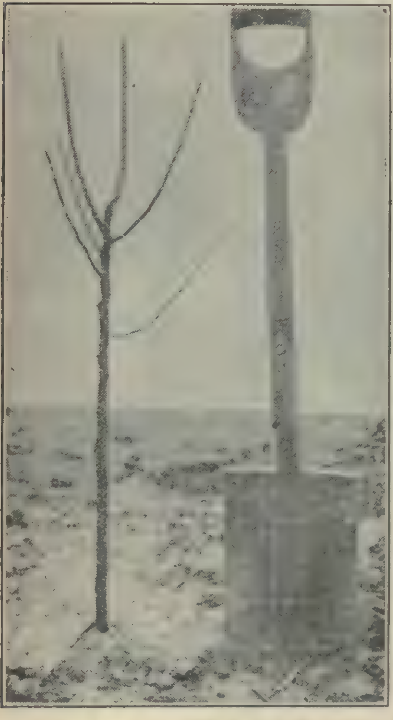

FIG. 9.—A 2-year-old apple tree pruned when planted with a view to developing an open-center top. This tree is one of those shown in figure 2.

Under ordinary conditions small fruits should be given about the same tillage that a well-cared-for vegetable garden receives, except that strawberries are not cultivated much in the spring until after the crop is harvested.

MAINTAINING SOIL FERTILITY.

Under most conditions the same methods of maintaining the fertility of the soil which are followed in a vegetable garden are successful with fruits. Where stable manure is available, its liberal use generally gives excellent results.

A considerable part of the value of stable manure is in the humus which it adds to the soil. If manure is not available, however, it may be beneficial to work into the soil leaves, cornstalks, straw, lawn clippings, or other refuse vegetable matter which will decay readily. Under some conditions rye or some other crop may be sown in the autumn, or after the season's cultivation is ended, and plowed under the following spring. Other cover crops may also be used as conditions permit.

No specific directions can be given for the use of commercial fertilizers, since the condition of the soil and the amount of plant food available in it vary widely and the needs of the soil for the best results can be determined only by experiment. The application of a complete fertilizer or such other forms of commercial plant food as experience may have proved to be successful generally in the growing of other crops on soil similar to that occupied by the fruit plantation is best in the fruit garden or home orchard.

PRUNING AND TRAINING.

While different details need to be considered in pruning different kinds of trees, the general principles are the same for all tree fruits. Pruning at the time the trees are planted is illustrated in figures 9 to 12. During the dormant period following the first season's growth, three to five branches should be selected to make the framework of the permanent top, if this was not done when the trees were planted. These branches are sometimes called the "scaffold" branches. They should be selected as far as possible with a view to their symmetrical arrangement and their relative positions up and down the trunk of the tree. When possible so to select them, there should be a space of at least 2 or 3 inches vertically between adjacent branches. If two of the main branches start from the trunk at the same level, they will be more likely to split down later in the life of the tree when it bears heavy loads of fruit than if they start from the trunk at different heights.

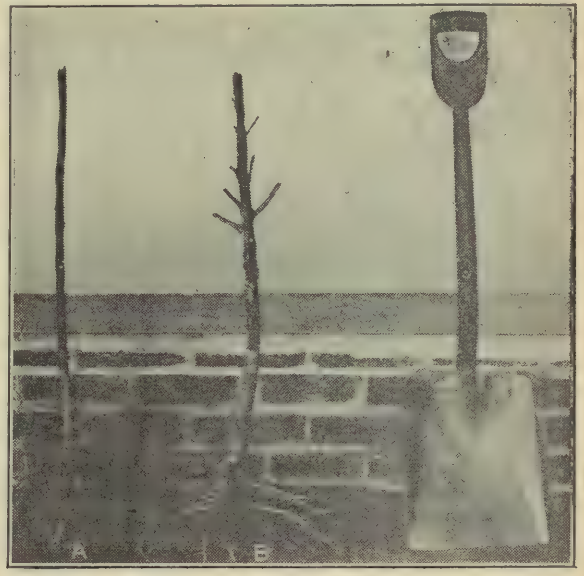

FIG. 10.—Peach trees trimmed ready to plant: *A*, 4 to 5 foot grade; *B*, 5 to 7 foot grade.

In order to make the main limbs strong and stocky and to control, in a measure, the branching of the tree in the second season's growth, from one-third to one-half, or sometimes even a larger portion, of the growth made during the first season is usually cut off in the subsequent dormant pruning. Some thinning out of the branches may also be necessary.

The pruning after the second season's growth is not unlike that of the first season. It should be done with a view to making the top symmetrical and to keep it open for the free access of sunshine and air. In order to accomplish this, some cutting out of superfluous branches will usually be necessary, as in the previous year. Again, in most cases more or less heading back of the previous season's growth should be done. In the opinion of some commercial fruit growers of wide experience, it is best to remove all except two of the side branches which have developed from the scaffold limbs during the second season's growth. Thus, after the second season's pruning is done there will remain only twice as many limbs from which growth will be renewed the following season as was the case when the pruning after the first season's growth was completed.

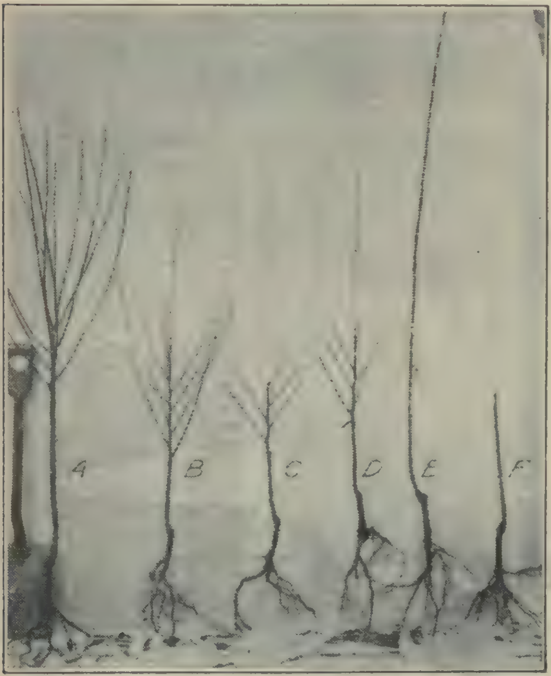

FIG. 11.—Cherry trees showing the methods of shaping the tops at the time of planting: *A*, a 2-year-old Large Montmorency unpruned; *B*, a 1-year-old Large Montmorency, unpruned; *C*, same as *B*, pruned to be grown with an open center; *D*, a 1-year-old Large Montmorency, pruned to be grown with a central leader; *E*, a 1-year-old Schmidt unpruned; *F*, same as *E*, headed back ready for planting.

With most fruit trees, pruning in after years should consist in keeping the tops free from superfluous growth, thus making them sufficiently open to permit every fruit bud and developing fruit to receive a maximum of sunlight.

The accompanying illustrations bring out more clearly the points mentioned above. Figure 13 shows an apple tree in August of the first season after planting. It was pruned when planted in much the same manner as the tree shown in figure 9, though the limbs, five in number, which were selected to form the framework of the top were rather more uniform in size.

As the tree in figure 13 began growth, two or more buds on each limb developed secondary branches in a manner nearly ideal for an open-center type of pruning. The growth made up to August is indicated by the branches which bear foliage. Probably they increased somewhat in length before the close of the growing season. The pruning to be done during the following dormant season will consist in cutting back the growth made the preceding season about one-half or more, depending on its length, and in removing entire branches if there are too many.

The forming of the top of an apple tree is further illustrated in figures 14 to 16, with their accompanying legends. These figures show the same tree in different stages of growth. The tree as it appeared in July, 1915, is seen in figure 16. Considerably more growth was made before the end of that season. The branches were not cut back after that season's growth. When growth was renewed in the spring of 1916, only buds near the ends of the 1915 growth developed branches, thus leaving unduly long unbranched limbs represented by nearly the entire growth made in 1915 (fig. 17). Had these limbs been cut back during the dormant season following the growth of 1915 to correspond with the condition shown in figure 15, the buds near the ends of the branches left in the cutting back would have developed secondary branches, as shown in figure 16 following the cutting back shown in figure 15, and the framework would have been kept better proportioned. The pruning done to correct the fault shown in figure 16 is indicated in figure 18. It is possible that the tree would have borne fruit earlier if the pruning had been less severe.

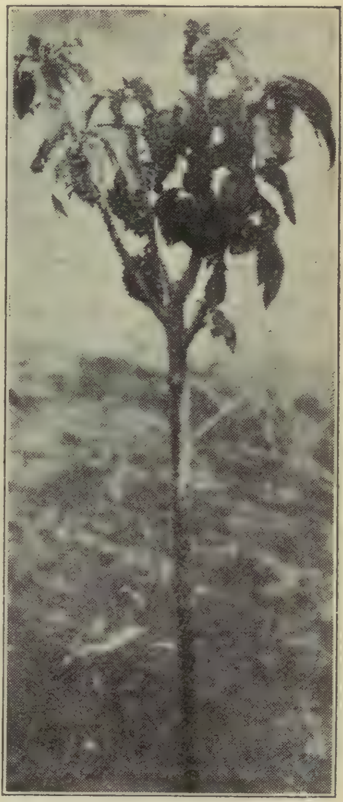
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FIG. 12.—A sweet-cherry tree of the Schmidt variety planted as a 2-year-old in the spring of 1915 and shaped with a view to its being pruned as an open-center tree. (Michigan, July 8, 1915.)

If the plan here suggested of cutting back and thinning out the new growth each year is followed for the first three or four years or until the frame of the top is well established, it may be well thereafter to do comparatively little pruning for the next few years or until the tree comes into bearing. However, the character and vigor of the growth will need to be considered each year and treated accordingly.

The ultimate results to aim for in a mature tree are suggested in figure 19. While this tree was not pruned entirely in accordance with the details outlined above, the results shown in the open well-balanced top that has been secured are fairly good.

Pear trees are pruned much like apple trees.

The essential features of pruning peach trees are shown in figure 20. The tree shown was cut to a straight unbranched stem when planted, and the four limbs which make the top developed before July 21 of the season when the photograph was taken. The tree doubtless made considerably more growth before the end of the season.

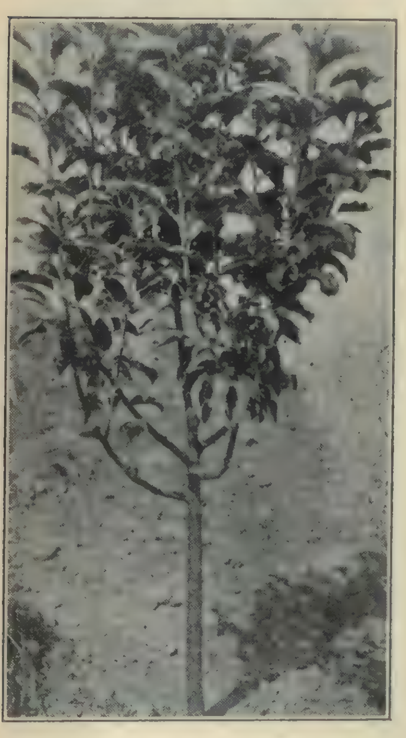

FIG. 13.—An apple tree in August of its first season's growth in the orchard. It was a 2-year-old tree when planted.

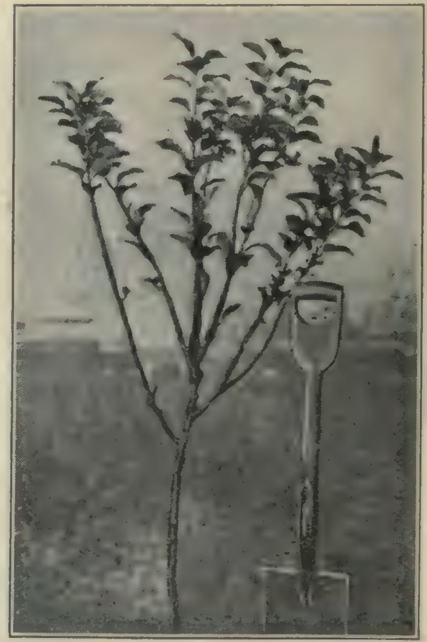

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FIG. 14.—A Delicious apple tree after two seasons' growth as it appeared before its annual pruning. The foundation for the top consists of four or five main limbs. Compare this with figures 15 and 16.

During the following dormant season the main limbs should be cut back and the side branches thinned out as may seem necessary to prevent the top from becoming too dense during the second season's growth. In general, this course should be followed each year, though the details will vary with the amount and strength of the annual growth which the tree makes. Figure 21 shows a peach tree 6 years old which has been pruned about as described.

Figure 22 shows a sour-cherry tree which has also been pruned to an open head, though comparatively little cutting back of the annual growth made by the main limbs has been practiced.

Plum trees are pruned about the same as cherry trees.

Quince trees make a rather slow growth, and the fruit is borne on the ends of the current season's growth. As soon as a fruit bud forms on the end of a twig the latter ceases to increase in length for the season. For this reason a quince tree does not increase in size as rapidly as most other fruit trees. Pruning quince trees therefore consists largely in removing dead branches, limbs that cross one another, and any superfluous growth that may develop.

The usual time for pruning fruit trees for the purpose of keeping them shapely and for removing superfluous wood is during the dormant season, preferably during the latter part of winter or early spring.

The manner in which the wounds are made when branches are removed has much to do with the rapidity and completeness of their healing. In removing a branch the surface of the wound should be as nearly as possible parallel with and close to the limb from which it is removed.

The results of leaving stubs are shown in figure 23. In this figure a stub, the end of which is dead, is shown at *A*. It will never heal over. In time it will decay. The normal course will be for the decay to extend into the trunk of the tree. A wound that is healing fairly well is shown at *B*, but a stub was left in cutting off the branch. It would have been better had the cut been made along the line *b*–*b*, even though the resulting wound would have been a little larger than the one that was made.

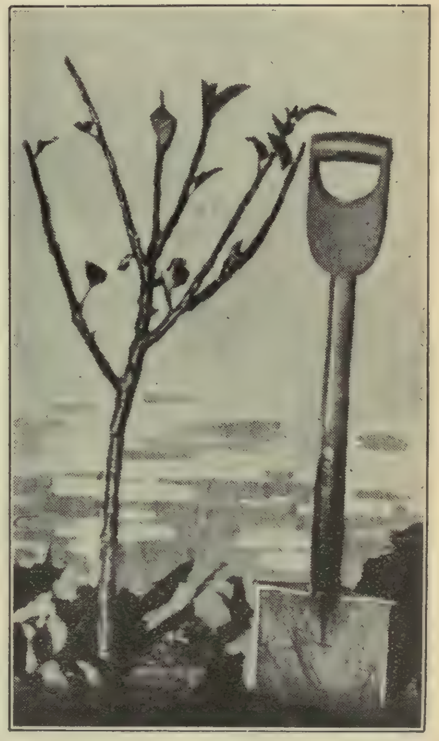

FIG. 15.—The tree shown in figure 14 after being pruned. Both figures were reproduced from photographs taken at Akron, Colo., November 12, 1914.

If the wounds from pruning are so large that they can not heal over in one or two seasons, some kind of protective coating is sometimes applied. A good grade of white lead thinned with linseed oil is recommended for this purpose.

The pruning and training of small fruits are discussed in considerable detail in Farmers' Bulletins which relate to the different fruits. These are listed on page 40.

CONTROL OF INSECT PESTS AND FUNGOUS DISEASES.

The same kinds of insect pests and fungous diseases that are found in a commercial orchard in any region may be expected to occur in a fruit garden or home orchard located in the same region. Therefore, in planning a home fruit plantation the grower should inform himself as completely as is possible in regard to the methods of controlling the common insects and diseases to which the fruits he is growing are subject in his locality. This information may be found in bulletins issued by State experiment stations, agricultural college extension divisions, the United States Department of Agriculture, and elsewhere. (See the list of Department of Agriculture bulletins, p. 40.)

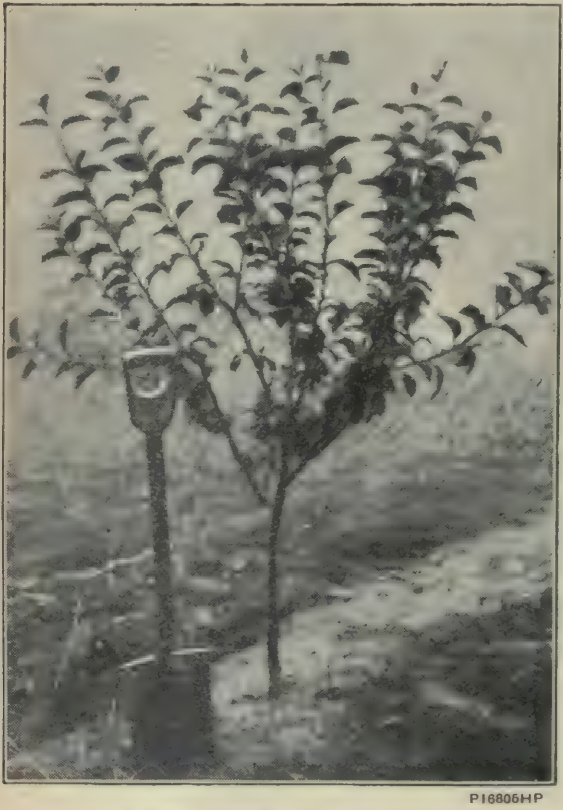

FIG. 16.—The same tree shown in figures 14 and 15 as it appeared in July of the following season. The buds near the ends of the stubs in figure 15 have developed into branches, thus making a good framework for a strong well-branched tree. (Akron, Colo., July 21, 1915.)

The present reference to the control of insect pests and fungous diseases is intended primarily to emphasize the importance of exercising great vigilance in this direction. Too often the home fruit plantation in the neighborhood of commercial orchards may become virtually a public nuisance as a breeding place and source of dissemination of serious insect pests and fungous diseases. In some States the law recognizes such places as a menace to public welfare and authorizes entry by duly appointed officials and the destruction of the infested trees or plants. Therefore, when a home fruit grower establishes his plantation he assumes certain obligations of a more or less public nature to maintain it in such a way that it will not interfere in any manner with the interests of others. If this is not the viewpoint and the spirit in which a home fruit plantation is planned, it would better not be established.

IRRIGATION.

In semi-arid regions irrigation is practically essential to the successful growing of many fruits, especially small fruits; and, in fact, in regions of limited rainfall it greatly increases the chances of success with all fruits. Even in humid sections fruit growers who have installed an irrigating system without undue cost often find that it pays well, since it gives them a means of averting losses which otherwise would be suffered in times of severe drought. This is true especially of strawberry and other small-fruit growers, though in some cases orchardists in humid sections have provided irrigation facilities for their orchards.

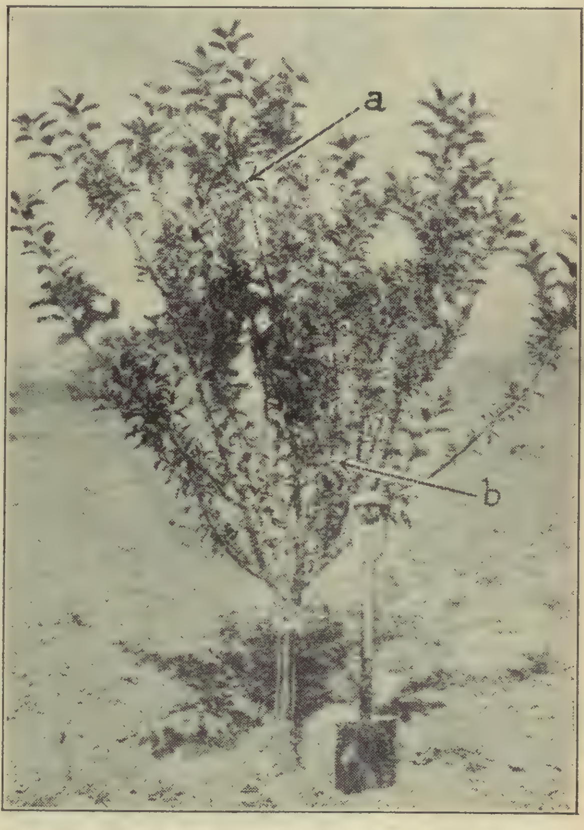

FIG. 17.—The tree shown in figure 16 as it appeared the last of August, 1916, no pruning having been done since November, 1914, when it appeared as shown in figure 15. **The growth (about 3 feet in length) between the arrows *a* and *b* is unbranched and is typical of all the limbs. This tends to raise the top unduly.**

Two systems of applying irrigation water are in more or less common use. In one—the overhead-spray system—the water is distributed through pipes supported on posts placed at intervals through the area to be irrigated, as illustrated in figure 24. The pipes are so perforated that when the water, which must be under some pressure, is turned into them, it is distributed over the entire surface that is to be covered. This system is used principally in irrigating strawberries and other low-growing plants.

In the other system, the water is distributed through furrows usually 3 to 4 feet apart between the rows. This system requires

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a uniform surface that slopes gently from the source of the water supply; or if the surface is so broken or hilly that it can not be leveled it will be necessary to make the furrows nearly parallel with the slopes. A young orchard furrowed for irrigation is shown in figure 25.

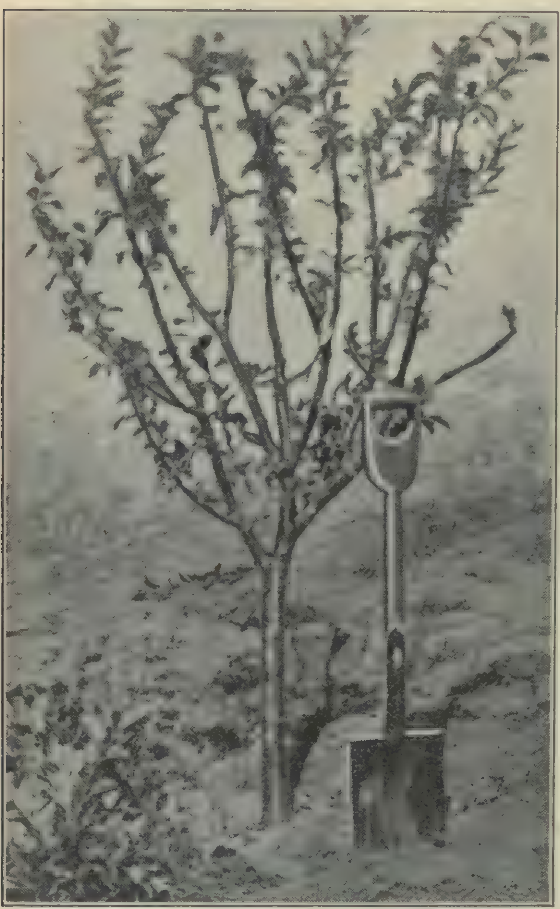

FIG. 18.—The tree shown in figure 17 after being pruned to correct the faults arising because it was not pruned after the seasonal growth of 1915. The severe pruning here indicated may have delayed fruiting somewhat, but the formation of a good top at this period of the tree's development seemed more important than early productiveness.

Still another method, the basin system, is sometimes used and may be adapted to the home orchard in place of the other systems. This consists essentially in making a large basin about each tree either by excavating the soil somewhat or by mounding up a ridge of soil around the tree at some distance from it. The water is conveyed into the basin thus made through a pipe or in some other way.

While the overhead and furrow systems are used primarily in commercial activities, they can be adapted readily to the home orchard or fruit garden.

Further information in regard to irrigation may be obtained in other bulletins issued by the United States Department of Agriculture.

VARIETIES OF FRUIT FOR DIFFERENT REGIONS.

In order that the amateur grower who has little knowledge of fruit varieties may be guided in his selections the country has been divided into 14 main districts, as shown by figure 26, and lists of varieties of the different kinds which are considered desirable for each district are given in later pages.

The lists are intended to be suggestive primarily, although the aim is to make them as useful as possible and to include only varieties which possess a high degree of merit for home use in the different districts.

Information in regard to varieties may be obtained from standard works on pomology; from bulletins of the State experiment stations, agricultural colleges and their extension divisions, and the United States Department of Agriculture; by correspondence with these public agencies; and from experienced fruit growers.

DESCRIPTION OF THE DIFFERENT FRUIT DISTRICTS.

While other factors aside from climate must be considered in selecting fruit varieties for growing in different regions, the temperature represents the most important limiting factor in the distribution of fruits and their varieties.

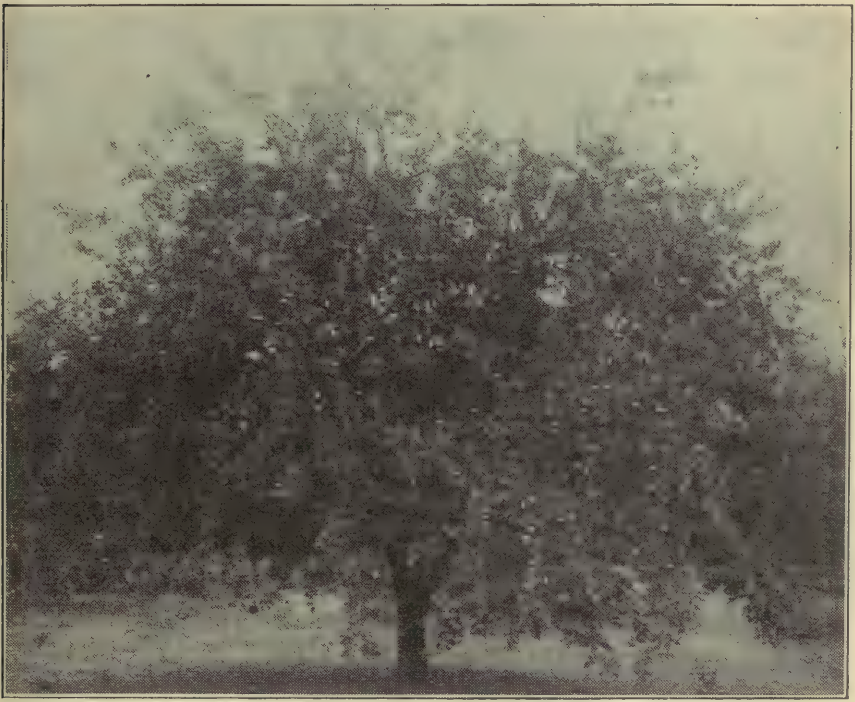

FIG. 19.—A desirable form for a mature apple tree, such as may be developed by judicious pruning. This tree is about 30 years old.

The lines on the map, which seem to indicate sharp and definite boundaries for the various districts, are arbitrary and really only approximate. As a matter of fact there is a constant gradation from one district to another. The only marked exceptions are local, as where a few hundred feet up or down a mountain slope brings one through very definite pomological zones in which there are well-defined differences in the behavior of the same variety or where large bodies of water modify the climatic conditions in a narrow belt along their shores, so that many fruits can be grown which do not succeed farther inland. Sharply defined soil differences of some kinds might also be included in this connection.

The following descriptions of the different districts will help the reader in making use of the lists of varieties which are given later.

District 1 includes the colder portions of New England, New York, and Michigan. Because of the low winter temperatures only varieties which are very hardy should be planted. In the more extreme portions some of the varieties suggested for this district may not be entirely hardy.

District 2 includes what is commonly termed the "northern fruit belt." To provide for certain differences in the adaptability of small fruits this district is subdivided into eastern and western sections.

District 3 includes certain regions of important commercial production of different fruits. Since it embraces practically all of the Appalachian Mountain system, with altitudes ranging from the highest east of the Rocky Mountains to practically sea level, the climatic conditions are extremely variable. Excluding the highest altitudes at which fruit is grown in this district, the varieties to be recommended for different sections are similar, with the exception of certain small fruits, to provide for which the district is divided into eastern and western sections. Since there is a correlation between altitude and latitude, it follows that many of the varieties, especially of the tree fruits named for district 2, can be grown with success at the higher altitudes in district 3.

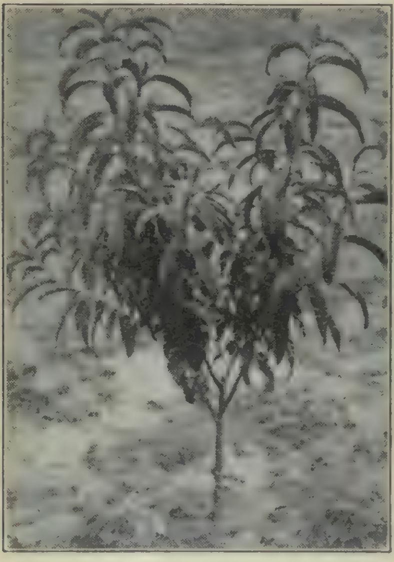

FIG. 20.—A peach tree in July of its first season's growth in the orchard. When planted it was pruned to a straight unbranched stem about 18 inches high.

District 4 is definitely southern in its climate, and many of the fruits which are grown in the more northern districts are not recommended, while certain fruits which can not be grown farther north appear in the lists. District 4 is subdivided into eastern and western sections.

District 5, together with the Coastal Plain region of district 4, includes practically all the Muscadine grape and subtropical fruit-growing regions of the country outside of California and southern Arizona.

District 6 includes the Ozark region and other important fruit districts of the central Mississippi, lower Missouri, and Arkansas River Valleys. Many of the varieties suggested are the same as those named for district 3.

District 7 differs considerably from district 6 in various climatic factors. The winter temperatures are more severe in the more northern district, and many of the varieties named for district 6 are replaced in district 7 by hardier sorts.

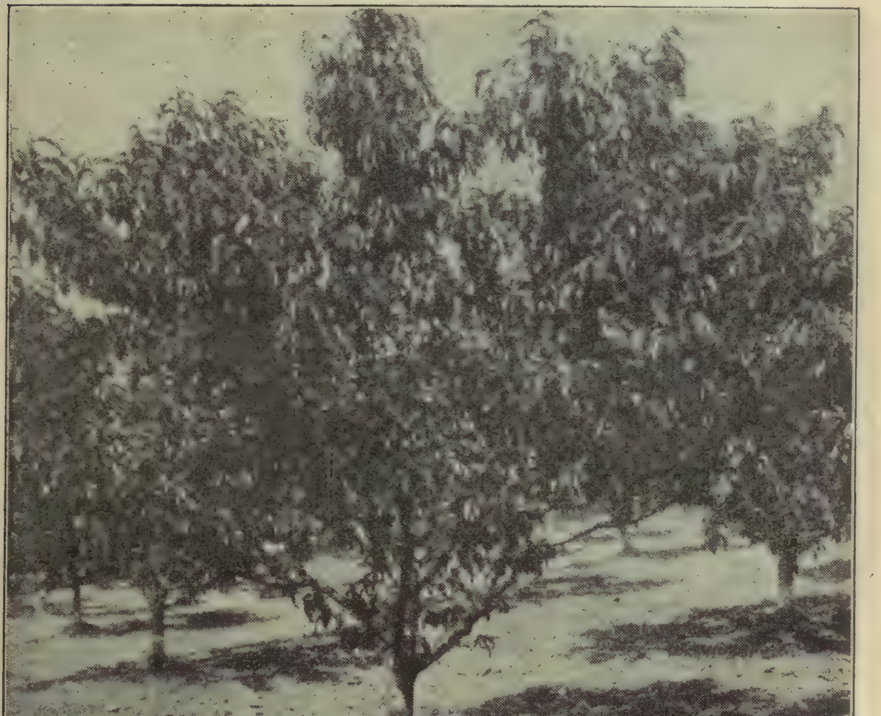

FIG. 21.—A well-formed 6-year-old peach tree which has had systematic pruning.

District 8 is characterized by low winter temperatures and drying winds. A large part of it, especially west of eastern South Dakota and eastern Nebraska, has very limited rainfall. It is a district in which the planting of only very hardy varieties can be advised.

District 9 has many of the characteristics of district 8, but in an intensified form. Comparatively few varieties possess sufficient hardiness with regard to low temperatures, drying winds, and drought resistance to be grown successfully in this district.

District 10 is a portion of the Great Plains area which is characterized by a comparatively high altitude, very limited rainfall, and more or less constant wind. Because of these elements the conditions are rather difficult for fruit growing.

District 11 is not as clearly defined in its characteristics as most of the others. Because of its southern location, even though with fairly high altitudes, the winter temperatures are mild. There are several irrigated districts in the Rio Grande and Pecos Valleys in New Mexico, and there is an irrigated region in the El Paso section in Texas in which fruits somewhat characteristic of a mild climate are being grown.

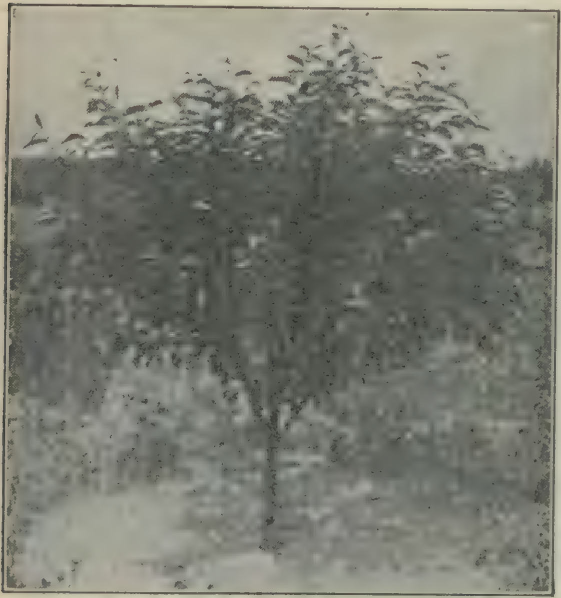
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FIG. 22.—A Montmorency cherry tree in its third season's growth from planting, pruned to an open center. (Michigan, July 9, 1915.)

District 12 is exceedingly variable, since it includes the Intermountain States, which are characterized by the high altitudes of the Rocky Mountains and by valleys provided with irrigation facilities, where intensive types of agriculture, including fruit growing, are carried on. From the standpoint of fruit growing, this district is made up substantially of at least three zones or regions. The conditions are adverse to fruit growing, practically to the point of being prohibitive, at altitudes exceeding about 7,000 to 8,000 feet. A second zone is represented by the irrigated valleys, in which a wide range of fruits and other crops can be grown. The third zone is represented by the areas where crop production of all kinds is restricted or attended with considerable difficulty on account of very limited rainfall and where irrigation can not be or has not been provided.

While conditions vary from north to south, the varieties which can be suggested for growing throughout this district, especially in the more favorable zone, are very similar. In the dry-land areas, where the conditions are adverse and where the altitudes are relatively high, many of the varieties named for district 8 will probably be more successful than a considerable proportion of those named for district 12.

In southern Utah and the northern portion of Arizona the climatic conditions, except at the higher altitudes, tend to preclude the growing of such fruits as the apple, currant, and gooseberry.

District 13 contains several important commercial fruit-producing areas, as the Puget Sound region in Washington, the Willamette and Rogue River Valleys in Oregon, and other areas. The mixture of varieties of northern and middle latitudes in the fruits grown in this district is rather noticeable.

District 14 admits of almost endless subdivisions, since within the district there are regions in which the climate is distinctly subtropical; also those in which there is perpetual snow. Within the fruit-growing sections of California the conditions naturally admit of division into coastal, interior valley, and foothill regions.

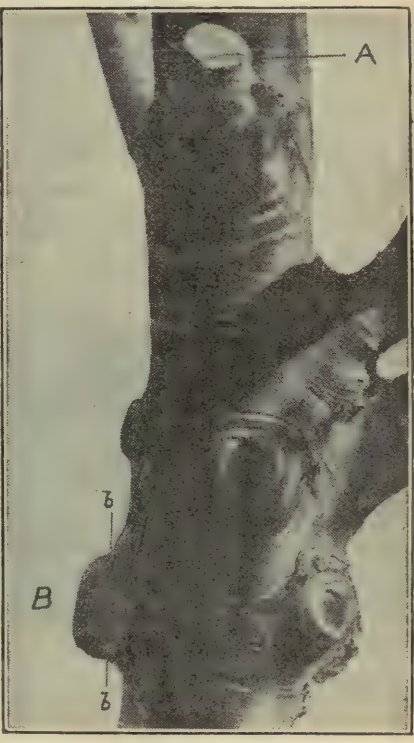

FIG. 23.—Wounds in pruning improperly made. At *A* is a long stub which will never heal over. The wound at *B* is healing fairly well, but better results would have followed had the limb been cut off in the line of *b–b*.

COMMENTS ON FRUIT VARIETIES.

APPLE VARIETIES.

The lists which follow are made up of varieties which are of value for home use in the different districts. As nearly as it is practicable to do so, the varieties are named in their approximate order of ripening, and they are grouped into early, midseason, and winter sorts. These terms are relative only, the season of use of the different varieties in many instances overlapping. This is true especially of the midseason and winter sorts. A considerable proportion of those which are grouped as midseason varieties may extend their ripening period into early winter, while the season of some of the varieties grouped as winter will begin in the late autumn. This grouping of the varieties is intended especially to help the grower whose plantings must be limited to a very few trees.

No crab apples are given in any of the lists. The Transcendent as an early variety and the Hyslop for a later sort so largely predominate among the crabs in most of the districts that it seems unnecessary to name others, except possibly the Florence, which is grown to some extent in the upper Mississippi Valley.

PEAR VARIETIES.

While the ideal home orchard or fruit garden is hardly complete without pears, the prevalence of pear-blight and its destructiveness render growing rather uncertain. The lists are made up in most cases of only a very few of the choicer sorts.

Pear varieties are so generally sterile with regard to their own pollen that it is always advisable in planting them to choose at least two sorts.

The Kieffer, as will be noted, appears in most of the lists. This variety blossoms somewhat earlier than most other pears; hence, to insure the most nearly perfect cross-pollination it is usually advisable to plant a tree of either the Garber or Le Conte with the Kieffer, as these three varieties blossom at approximately the same time.

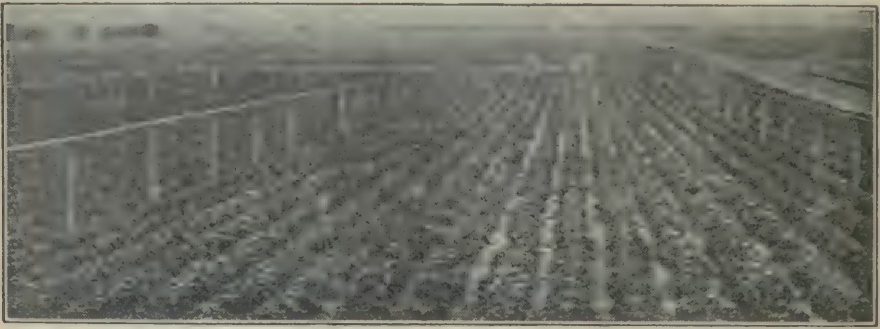

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FIG. 24.—A strawberry field provided with an overhead-spray system of irrigation. The water is distributed through perforated pipes supported on posts. (Photographed at Bridgeton, N. J.)

PEACH VARIETIES.

The varieties listed represent the choicer sorts for their seasons and are named, so far as possible, in the order in which they ripen. As a rule, the very early varieties are poor in dessert quality, and where only a very small number of trees can be planted, the grower will do well to choose some of the midseason or later varieties of better quality. In many instances, also, the very late varieties will be less desirable for home planting than the midseason sorts.

The characteristics which are usually of the most concern to the grower are the color of the flesh and the adhesion of the flesh to the stone. To supply this information in brief, certain letters appear in parentheses after each variety, as follows: c = clingstone, f = freestone, fc = sometimes freestone and sometimes clingstone (or in some cases the flesh separates from the stone with little difficulty, yet not with perfect freedom), r = red flesh, w = white flesh, y = yellow flesh.

PLUM VARIETIES.

The plum varieties in the various lists are named without reference to any particular order of ripening.

The Japanese varieties and most native ones are usually sterile with regard to their own pollen. It is, therefore, always advisable in planting even two trees to select one each of two varieties which blossom at the same time. A single tree isolated from other plums is likely to prove unproductive even though it may blossom freely.

CHERRY VARIETIES.

The number of varieties of cherries to be recommended for planting is small. In some of the lists the varieties named are grouped under "Sour" and "Sweet." When no sweet varieties are named, it is to be understood that the planting of them is not advised in the districts to which the lists apply. Where only a single sour variety is desired, the Montmorency should usually be given the preference. The naming of other sour varieties is only for the purpose of extending the cherry season.

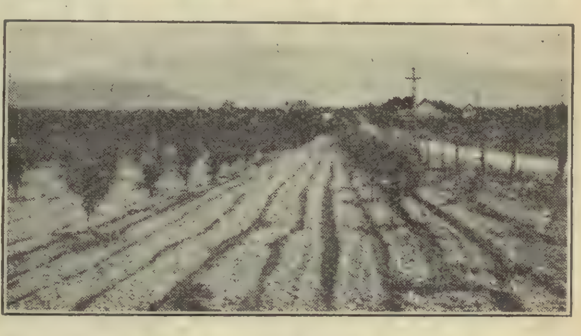

FIG. 25.—A small irrigated orchard in which the water is distributed by the furrow system. The furrows receive the water from a cross furrow or head ditch which extends along the upper side of the tract.

Most varieties of sweet cherries are sterile with regard to their own pollen, and some of the varieties, unlike most other kinds of fruits in which self-sterility is common, are sterile with each other. In most of the districts in which both sweet and sour varieties are planted together, there appears to be little difficulty with regard to the satisfactory fruiting of the sweet varieties; but in districts 13 and 14 and in some parts of district 12, where sour cherries are rarely planted and in which the sweet cherry is of great importance, the trees frequently do not bear well, owing probably to self-sterility or to the sterility between different varieties.

It has been determined by the Oregon Agricultural Experiment Station that the Tartarian and Republic will cross-fertilize most other sweet varieties.

APRICOT VARIETIES.

Apricots are suggested only for districts 12, 13, and 14. On account of the fact that they habitually blossom very early in the spring and are, therefore, extremely subject to injury by frosts, they are not adapted to growing generally throughout the United States.

QUINCE VARIETIES.

A single variety, the Orange, comprises most of the quinces that are grown throughout the country. This fruit succeeds best in the northern districts.

The Rea and Champion are planted occasionally and ripen after the Orange. The Van Deman is sometimes reported from the South.

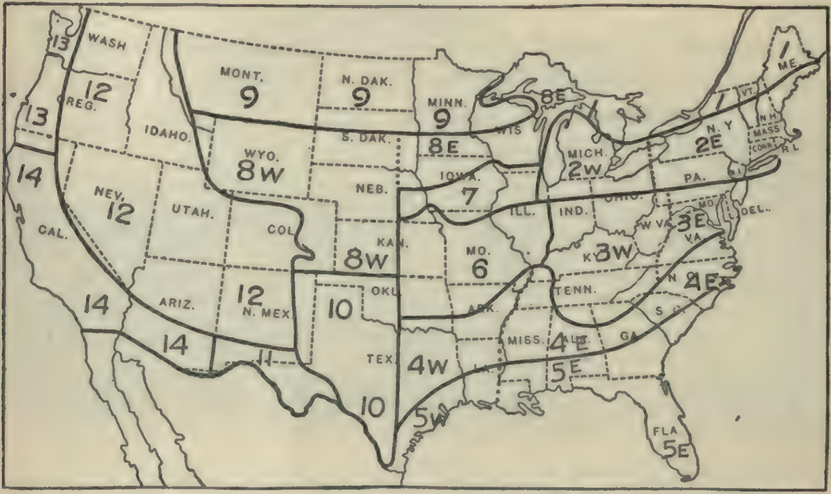

FIG. 26.—Map of the United States, showing the districts into which the country is divided for use in applying the fruit-variety lists.

The Pineapple variety should be planted in home gardens in the Pacific Coast States.

BLACKBERRY VARIETIES.

In the list of blackberries for the western section of districts 4 west and 5 west the McDonald is followed by the word "self-sterile"; the Dallas or the Haupt may be used to pollinate it. In the list for district 14 the Mammoth is similarly designated; the Logan may be used to pollinate it.

STRAWBERRY VARIETIES.

The flowers of strawberry plants are classed as perfect or imperfect according to whether they have both pistils and stamens or pistils only. The imperfect-flowered varieties are usually set with perfect-flowered ones, two rows of the former alternating with one row of the latter. In order to indicate the sorts that do not bear fruit when set alone the abbreviation "imp." has been placed in parentheses after the name of each imperfect-flowered variety in the lists for different districts.

AGE OF BEARING.

Not infrequently amateur fruit growers expect fruit from their trees much sooner after planting than they should, and disappointment is inevitable. The statements that follow concerning the age at which different fruits bear will serve as a general guide. The age of a tree is usually reckoned from the time it is planted in its permanent place.

Apple trees should begin to bear, as a rule, when they have been planted six to eight years. Certain varieties, as the Yellow Transparent and Wagener, may bear considerably younger, and others, such as the Northern Spy and Yellow Newtown, not until they are somewhat older. Individual trees of the same variety vary somewhat in this respect.

Pear trees bear, in general, at about the same age as apple trees, though perhaps a little younger.

Peach trees under favorable conditions often bear at three years of age, and in any event they should bear at four years unless injured by frost or otherwise.

Plums vary considerably according to the group to which they belong, but most sorts begin to bear in four or five years after planting.

Sour cherries ordinarily begin to bear in about four years and sweet cherries at six or seven years after planting.

Apricots come into bearing at about the same age as peaches, or sometimes a little later.

Quinces are usually five or six years old before they bear much fruit.

Raspberries, blackberries, and dewberries, if planted in the spring, should bear a light crop the next year. Strawberries planted in the spring or early enough in the autumn to make a good growth before the advent of cold weather should produce a good crop the next season.

Currants and gooseberries commonly bear a few fruits the third season after planting.

Grapes may bear very lightly the third season where conditions are favorable, but not much fruit should be expected earlier than the fourth year.

LISTS OF VARIETIES FOR DIFFERENT DISTRICTS.

DISTRICT 1.

Varieties marked with an asterisk (*) are of special importance for the colder sections of the district. For an explanation of the abbreviations used in connection with peaches, see under "Peach varieties" (p. 29); under strawberries the abbreviation imp. = imperfect. A synonym is shown by printing the name in italic type in parentheses.

Apples.—Early: Yellow Transparent, *Oldenburg (*Duchess*), Tetofski, Peach (*Peach of Montreal*). Midseason: *Wealthy, *Dudley, Fameuse. Winter: McIntosh, Bethel, *Scott Winter, Tolman (sweet).

Pears.—Flemish (in milder sections), Clapp Favorite (in milder sections).

Peaches.—Planting not advised.

Plums.—Arctic (*Moore Arctic*), De Soto, Forest Garden, Wolf, Cheney.

Cherries.—Richmond, Montmorency.

Raspberries.—Herbert,[1] Ranere (*St. Regis*).[1]

Blackberries.—Snyder.[1]

Dewberries.—Planting not advised.

Currants—Perfection (red), White Imperial.

Gooseberries.—Downing.

Strawberries.—Dunlap, Warfield (imp.), Progressive.

Grapes.—Planting not advised.

DISTRICT 2.

EAST AND WEST AS A WHOLE.

The following varieties are suggested for all of district 2, aside from the exception noted.

Apples.—Early: Yellow Transparent, Early Harvest, Oldenburg, Primate, Williams, Jefferis, Benoni, Maiden Blush, Gravenstein. Midseason: Wealthy, Ramsdell (sweet), Fall Pippin, Mother, Hubbardston. Winter: McIntosh, Tompkins King, Tolman (sweet), Rhode Island Greening, White Pippin, Baldwin, Northern Spy.

Pears.—Giffard, Tyson, Bartlett, Seckel, Howell, Bosc, Anjou, Lawrence, Winter Nelis.

Peaches.—Greensboro (w fc), Carman (w fc), St. John (y f), Champion (w fc), Reeves (y f), Oldmixon Free (w f), Elberta (y f), Late Crawford (y f), Chairs (y f), Stevens (w f), Smock (y f).

Plums.—Bradshaw, Lombard, Diamond, Reine Claude, Grand Duke, Archduke, Jefferson, Monarch, Middleburg, Italian (prune), Shropshire (damson). Japanese varieties: Red June, Abundance, Burbank, Chabot.

Cherries.—Sour varieties: Richmond, Montmorency, English Morello. Sweet varieties: Tartarian, Spanish, Windsor.

Raspberries.—Cuthbert (red), Golden Queen (yellow), Cumberland (black), Columbian (purple).

Blackberries.—Eldorado (except along northern border in New England), Snyder, Mersereau.

Dewberry.—Lucretia.

Currants.—Perfection (red), White Imperial.

Gooseberry.—Downing.

Strawberries.—Early: Dunlap. Late: Belt (*William Belt*), Sample (imp.).

Grapes.—White: Diamond, Empire State, Niagara, Winchell. Red: Brighton, Brilliant, Delaware, Salem. Black: Concord, Ives, Moore, Worden.

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[1] Hardy in the more favorable parts of this area.

EAST AND WEST SEPARATELY.

The following varieties are suggested for district 2, east: *Gooseberry*—Columbus (European); *raspberries*—Herbert, Marlboro (both red), and Farmer (black); *strawberry*—Marshall (early). For district 2, west; *Currant*—London (red); *raspberry*—King (red); *strawberry*—Bubach (imp.).

DISTRICT 3.

EAST AND WEST AS A WHOLE.

The following varieties are suggested for all of district 3, aside from the exceptions noted:

Apples.—Early: Yellow Transparent, Early Harvest, Early Ripe, Red June, Williams, Benoni, Horse, Maiden Blush, Wealthy. Midseason: Smokehouse, Bonum, Delicious, Grimes, Kinnard. Winter: York Imperial, Rome Beauty, White Pippin, Stayman Winesap, Winesap, Royal Limbertwig.

Pears.—Bartlett (in Pennsylvania, Ohio, and Indiana only), Seckel, Kieffer.

Peaches.—Mayflower (w c), Early Wheeler (w c), Greensboro (w fc), Arp (y c), Carman (w fc), Hiley (w fc), Belle (w fc), Ray (w fc), Reeves (y f), Elberta (y f), Frances (y f), Late Crawford (y f), Chairs (y f), Smock (y f), Levy (y c), Salwey (y f).

Plums.—Native and hybrid varieties: America, Forest Rose, Gonzales, Milton, Miner, Munson, Newman, Poole Pride, Pottawattamie, Robinson, Whitaker, Wildgoose. Japanese varieties: Red June, Abundance, Burbank, Chabot.

Cherries.—Same as for district 2, but with decreasing value southward.

Raspberries.—Cuthbert (red), Golden Queen (yellow), Cumberland (black), Columbian (purple).

Blackberries.—Early Harvest, Eldorado, Evergreen (in New Jersey only).

Dewberry.—Lucretia.

Currants.—Perfection (red), White Imperial.

Gooseberry.—Downing.

Strawberries.—See below.

Grapes.—White: Diamond, Niagara, Winchell. Red: Brighton, Brilliant, Delaware. Black: Concord, Moore, Worden.

EAST AND WEST SEPARATELY.

The following varieties are suggested for district 3, east: *Gooseberry*—Columbus (European); *raspberry*—Ranere (red); *strawberries*—Prémier (early), Success (early), Joe (late), Chesapeake (late); *grapes*—Elvira (white), Lutie (red), Ives (black). For district 3, west: *Currant*—London (red); *dewberry*—Mayes (*Austin*); *raspberry*—King (red); *strawberries*—Dunlap, Bubach (imp.) (both varieties except in Tennessee and southward), Thompson (in Tennessee and southward), Aroma (throughout section); *grapes*—Martha (white), Catawba (red), Carman (black).

DISTRICT 4.

EAST AND WEST AS A WHOLE.

Apples.—Early: Yellow Transparent, Red June, Early Harvest, Red Astrachan, Horse, San Jacinto, Bledsoe. Midseason: Bonum, Kinnard. Winter: Winesap, Texas Red, Yates, Terry.

Pears.—Kieffer (with Le Conte or Garber).

Peaches.—Same as for district 3, though the late varieties should probably be omitted.

Plums.—Same as for district 3.

Cherries.—Planting not advised.

Japanese persimmons.—See district 5.

Figs.—See district 5.

EAST SEPARATELY.

Raspberry.—Ranere (above 500 feet altitude).

Blackberry.—Early Harvest (above 500 feet altitude).

Dewberry.—Lucretia.

Strawberries.—Klondike, Missionary, Thompson.

Currants and *gooseberries.*—Planting not advised.

Grapes.—White: Diamond, Empire State, Elvira, Niagara. Red: Agawam, Brighton, Brilliant, Delaware. Black: Concord, Carman, Moore, Diamond. Along the Atlantic coast and extending about 100 miles inland the varieties of the Muscadine group of grapes also succeed. These include Thomas, James, Eden, Flowers, Mish, and Scuppernong.

WEST SEPARATELY.

Blackberries.—Early Harvest, Dallas, McDonald (self-sterile), Haupt.

Dewberry.—Mayes (*Austin*).

Strawberries.—Klondike, Thompson.

Raspberries, currants, and *gooseberries.*—Planting not advised.

Grapes.—White: Gold Coin, Wapanuka, Winchell, Rommel. Red: Headlight, Brilliant, Brighton, Last Rose. Black: Husmann, Fern (*Fern Munson*), Moore, Carman.

DISTRICT 5.

EAST AND WEST AS A WHOLE.

Apples.—Planting not advised.

Pear.—Kieffer (with Le Conte or Garber).

Peaches.—Jewel (y f), Honey (w f), Imperial (w f), Pallas (w f), Waldo (w f), Florida Gem (w f), Climax (w f), Colon (w f), Triana (w f), Angel (w f), Hall Yellow (y f), Cabler (r c), Estella (y f), Onderdonk (y f).

Plums.—Six Weeks, Excelsior, Terrell, America, Poole Pride. Japanese varieties: Red June, Abundance, Burbank, Kelsey.

Cherries.—Planting not advised.

Japanese persimmons.[1]—Tanenashi, Hachiya, Hyakume, Okame, Triumph, Tamopan, Eureka, Zengi, Costata, Ormond, Gailey,[2] Masugata.[2]

Figs.—Celeste,[3] Turkey[3] (*Brown Turkey*), Brunswick, Ischia, Lemon, Magnolia.[4]

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[1] Comparatively little definite information exists in regard to the range of adaptability of different persimmon varieties. This list includes the principal sorts that are planted in the South Atlantic and Gulf States. Tanenashi is probably grown more extensively at present than any other sort. The Eureka has proved especially hardy and desirable in Erath County, Tex., about 60 miles southwest of Fort Worth, and also at one or two points considerably farther north. The Tamopan is a Chinese variety and may possess a greater degree of hardiness than was formerly supposed. Zengi is one of the earliest varieties. Costata and Ormond may be too late for growing in most parts of district 4.

[2] Gailey and Masugata are not of much value for their fruit, but, unlike the other varieties, the trees have both pollen-bearing and fruit-producing blossoms. As a rule, these two types of blossoms are borne on separate trees. While some varieties produce fruit without pollination, others do not; hence, in planting any large number of persimmons it is advisable to include a pollen-producing sort.

[3] The Celeste is regarded as the hardiest variety of this group, with Turkey perhaps only slightly less hardy. The former is much more widely planted than any of the others in the list. These two sorts should be planted in district 4 in preference to the others, unless possibly in a few especially favorable localities.

[4] The Magnolia is planted in the Gulf coast region of Texas nearly to the exclusion of other varieties. It is not satisfactory in other parts of district 5, except possibly in the southwestern part of Louisiana.

Grapes.—White: Wapanuka, Hidalgo, Niagara, Krause. Red: Brighton, Captivator, Agawam, Valhallah. Black: R. W. Munson, Cloeta, Carman, Champenel. The varieties of the Muscadine group named under district 4, east, are also adapted to most parts of district 5. By adopting special methods of training and by grafting on resistant stocks, certain varieties of Vinifera or European grapes have been grown with some success. However, they are not recommended for general planting in this district.

EAST SEPARATELY.

Raspberries, blackberries, dewberries, currants, gooseberries, and *strawberries.*—Same as for district 4, east.

WEST SEPARATELY.

Raspberries, blackberries, dewberries, currants, gooseberries, and *strawberries.*—Same as for district 4, west.

DISTRICT 6.

Apples.—Early: Yellow Transparent, Early Harvest, Red June, Oldenburg, Benoni, Maiden Blush, Wealthy. Midseason: Grimes, Jonathan, King David, Delicious. Winter: York Imperial, Stayman Winesap, Winesap, Ingram.

Pears.—Bartlett, Seckel, Anjou, Kieffer.

Peaches.—Early Wheeler (w c), Greensboro (w fc), Arp (y c), Carman (w fc), Hiley (w fc), Belle (w fc), Family Favorite (w fc), Elberta (y f), Stevens (w f), Stump (w f), Smock (y f).

Plums.—Native and hybrid varieties: De Soto, Miner, Surprise, Terry, Whitaker, Hawkeye, Pottawattamie. Golden (*Gold*), Brittlewood, Emerald. Japanese varieties: Red June, Abundance, Burbank.

Cherries.—Richmond, Montmorency.

Raspberries.—King (red), Pearl (black), Cardinal (purple).

Blackberries.—Mersereau, Eldorado, Early Harvest.

Dewberries.—Lucretia, Mayes (*Austin*).

Currants.—Perfection (red), London (red). White Imperial.

Gooseberries.—Downing, Oregon.

Strawberry.—Dunlap.

Grapes.—White: Winchell, Diamond, Noah, Elvira. Red: Brilliant, Lutie, Catawba, Brighton. Black: Moore, Concord, Worden. Bacchus.

DISTRICT 7.

Apples.—Early: Yellow Transparent, Livland Raspberry, Oldenburg, Charlamoff, Whitney, Benoni, Dyer. Midseason: Wealthy, Brilliant, Patten. Ramsdell (sweet), Roman Stem. Winter: Banana, White Pearmain, Northwestern, Black Annette, Delicious, Tolman (sweet), Windsor, Stayman Winesap, Ralls.

Pears.—Flemish, Bartlett, Seckel, Kieffer.

Peaches are uncertain at the best in this district. In favorable seasons the following varieties would probably fruit in some sections: Greensboro (w fc), Champion (w f), Bailey (w fc), Crosby (y f), Wright (w fc), Russell (w f), Bokhara (w f). Lone Tree (y f).

Plums.—Forest Garden, Stoddard, Wolf, Surprise, Rockford, Hawkeye, Terry, De Soto, Wyant, Miner, Emerald. Brittlewood.

Cherries.—Timme, Richmond, Montmorency.

Raspberries.—King (red), Sunbeam (red), Minnesota No. 4 (red), Older (black), Columbian (purple).

Blackberries.—Eldorado, Snyder.

Dewberries.—Planting not advised.

Currants.—Perfection (red), London (red), White Imperial.

Gooseberries.—Downing, Carrie.

Strawberries.—Dunlap, Warfield (imp.).

Grapes.—White: Diamond, Niagara, Noah, Winchell. Red: Brighton, Catawba, Lutie, Woodruff. Black: Concord, Ives, Moore, Worden.

DISTRICT 8.

EAST AND WEST AS A WHOLE.

Apples.—Early: Yellow Transparent, Livland Raspberry, Oldenburg, Iowa Beauty, Benoni. Midseason: Wealthy, McMahan, Anisim, Wolf River, Utter, Peerless, Plumb Cider. Winter: McIntosh, Patten, Northwestern, Jewell Winter, Milwaukee, Scott Winter, Malinda.

Pears.—Flemish, Warner.

Peaches.—Planting not advised.

Plums.—De Soto, Forest Garden, Cheney, Wolf, Wyant, Stoddard, Surprise, Rollingstone, Waneta. Sand cherry-plum hybrids: Compass, Hanska, Sapa, Opata, Sansota, Cheresota, Wachampa.

Cherries.—Timme, Richmond, Montmorency.

EAST SEPARATELY.

Raspberries, blackberries, dewberries, currants, gooseberries, and *strawberries.*—Same as for district 7, except that the Columbian raspberry should be omitted.

Grapes.—White: Diamond, Niagara, Noah, Winchell. Red: Brilliant, Delaware, Merrimac, Woodruff. Black: Concord, Ives, Moore, Worden.

WEST SEPARATELY.

The same varieties of currants and gooseberries are suggested as for district 7. On account of limited precipitation, raspberries, blackberries, and strawberries are not likely to be very satisfactory in district 8, west, except under irrigation. If water can be applied, and perhaps winter protection given, the same varieties as those suggested for district 7 may prove of some value. Conditions are similar with reference to grapes. No varieties can be recommended for this section with confidence of success, but where irrigation and winter protection can be given the following may be worth trying: White—Diamond, Lady, Martha, Niagara; red—Agawam, Catawba, Delaware, Vergennes; black—Concord, Hartford, Isabella, Worden.

DISTRICT 9.

Apples.—Oldenburg (*Duchess*), Patten, Okabena, Hibernal.

Pears.—Planting not advised.

Peaches.—Planting not advised.

Plums.—The list for district 8 contains the varieties of most importance for district 9. The sand cherry-plum hybrids are also of value in many sections of district 9.

Cherries.—The varieties named for other districts are not likely to be hardy, as a rule, in this district. Sand cherries, however, are of value for jellies, etc. Buffalo berries and other native wild fruits are also used for jelly making.

Currants.—Perfection (red), London (red), White Imperial.

Gooseberries.—Downing, Carrie.

Strawberries.—With winter protection: Dunlap, Warfield (imp.), Progressive.

Raspberries, blackberries, and *dewberries.*—Planting not advised.

Grapes.—The conditions are not well adapted to grape growing, and only the very hardy sorts are likely to succeed even in the more favorable locations.

The ones suggested for trial are Alaska, Beta No. 1, Beta No. 2, Beta No. 3, Bicolor, Dakota, and Janesville.

DISTRICT 10.

Apples.—Early: Yellow Transparent, Red June, San Jacinto, Maiden Blush, Gravenstein, Wealthy. Midseason: Grimes, Jonathan, Kinnard. Winter: Northwestern, Texas Red, Winesap, Missouri, Arkansas Black, Ralls, Limbertwig.

Pears.—Bartlett, Seckel, Kieffer.

Peaches.—Alexander (w c), Sneed (w c), Triumph (y c), Arp (y c), Carman (w fc), Mamie Ross (w fc), Chinese Cling (w c), Elberta (y f), Lee (*General Lee*) (w c), Krummel (y f), Heath (w c).

Plums.—Six Weeks, De Soto, Golden (*Gold*), America, Hammer, Poole Pride, Pottawattamie, Laire, Robinson, Wayland, Whitaker, Wildgoose, Wolf, Wooten.

Cherries.—Richmond, Montmorency.

Raspberries.—Of doubtful value.

Blackberries.—Crandall, Early Harvest.

Dewberry.—Mayes (*Austin*).

Strawberries.—Klondike, Arizona, Michael.

Blackberries, dewberries, and strawberries are likely to fail in district 10 without irrigation, on account of limited precipitation.

Currants and *gooseberries.*—The same varieties listed for district 7 are suggested for trial in district 10.

Grapes.—White: Hidalgo, Krause, Rommel, Wapanuka. Red: Captivator, Ellen Scott, Headlight, Marguerite. Black: Bailey, Champenel, Fern, Husmann.

DISTRICT 11.

Apples.—Early: Yellow Transparent, Early Harvest, Red June, Maiden Blush. Midseason: Wealthy, Grimes, Jonathan, Delicious. Winter: Winesap, Missouri, Rome Beauty, Arkansas Black, White Pearmain.

Pears.—Bartlett, Seckel, Kieffer.

Peaches.—Alexander (w c), Triumph (y c), Greensboro (w fc), Carman (w fc), Ray (w fc), Texas (*Texas King*) (w fc), Mamie Ross (w fc), Belle (w fc), Elberta (y f), Late Crawford (y f), Crothers (w fc), Krummel (y f), Salwey (y f).

Plums and *cherries.*—Very few grown. Probably the varieties suggested for district 10 would furnish satisfactory supplies for home use.

Little information exists concerning the adaptability of bush-fruit varities to this district.

Raspberries.—Of rather doubtful value.

Blackberries, dewberries, and *strawberries.*—The varieties named for district 10 are suggested for district 11.

Currants and *gooseberries.*—The varieties named for district 12 are suggested for trial in district 11.

Grapes.—No very definite suggestions are possible with reference to varieties. In some places along the Pecos River and the Rio Grande a few Old World varieties are grown, of which the Mission is the principal one. Sultanina, Sultana, Muscat, Alexander, and Black Hamburg might succeed, but all of these varieties should probably have winter protection.

DISTRICT 12.

Apples.—Early: Yellow Transparent, Red June, Red Astrachan, Early Harvest, Gravenstein. Midseason: Grimes, Jonathan, Ortley, Wagener. Winter:

Delicious, Rome Beauty, Banana, Stayman Winesap, Winesap, White Pearmain, Arkansas (*Mammoth Black Twig*), Arkansas Black.

In some of the irrigated valleys in Washington the Esopus and Yellow Newtown are also grown, but they do not occur as widely as most of the varieties named in the above list. The McIntosh is one of the most important varieties in the Bitter Root Valley in Montana.

Pears.—Bartlett, Flemish, Anjou, Winter Nelis.

Peaches.—Alexander (w c), Early Hale (w fc), Early Crawford (y f), Elberta (y f), Muir (y f), Late Crawford (y f), Lovell (y f).

Plums.—Japanese varieties: Red June, Abundance, Burbank, Wickson, Satsuma. European varieties: Bradshaw, Lombard, Reine Claude (*Green Gage*), Peach, Columbia, Washington, Yellow Egg, Pond.

Prunes.—Italian, Silver, Agen (French), Hungarian, German, Tragedy.

Cherries.—Sour varieties: Richmond, Montmorency. Sweet varieties: Tartarian, Bing, Napoleon (*Royal Ann*), Republican, Lambert.

Apricots.—Moorpark, Blenheim, Royal, Tilton. Apricots habitually blossom very early in the spring; hence the blossoms are often killed by frosts except in very favorable localities.

Raspberries.—Marlboro, Cuthbert.

Blackberries.—Eldorado, Lawton, Snyder, Logan' (in the milder valleys of Idaho, Oregon, and Washington).

Dewberry.—Lucretia.

Currants.—Perfection (red), White Imperial.

Gooseberries.—Oregon, Poorman.

Strawberries.—Dunlap, Jucunda (in Colorado and Utah), Clark, Superb.

Grapes.—In the milder portions of district 12, especially in the southern part, some of the Vinifera, or Old World, varieties may be grown, the Sultanina being the favorite one. In some parts of Idaho and Oregon, with winter protection, the more hardy varieties of the Old World grapes have given fairly good results. These include such sorts as the Black Hamburg, Chasselas de Fontainbleau, Flame Tokay, Jura Muscat, Sylvaner, and Zinfandel. American varieties suggested for trial planting in this district are Diamond, Niagara, Winchell, Brighton, Delaware, Concord, Isabella, and Worden.

DISTRICT 13.

Apples.—Most of the varieties in the list for district 12 occur widely in district 13. However, in the Puget Sound region such varieties as Alexander, Tompkins King, McIntosh, Rhode Island Greening, Baldwin, and Northern Spy, together with Gravenstein and Wagener of the list named for district 12, are relatively the most important sorts. Most of the above-named sorts also are grown to a limited extent in other parts of district 13 as well as at the lower altitudes in the eastern part of Oregon.

Pears.—Bartlett, Howell, Bosc, Anjou, Comice, Winter Nelis.

Peaches, plums, prunes, apricots, and *cherries.*—Substantially the same as for district 12.

Raspberries.—Cuthbert (red), Antwerp (red), Golden Queen (yellow).

Blackberries.—Eldorado, Snyder, Evergreen, Logan.

Dewberries.—Lucretia, Gardenia.

Currants.—Perfection (red), White Imperial.

Gooseberry.—Oregon.

Strawberries.—Gold Dollar (early), Marshall, Magoon, Oregon, Clark (for canning), Superb.

Grapes.—Conditions in western Washington are not favorable for grape growing. In western Oregon the same varieties suggested for district 12 may be grown without winter protection.

DISTRICT 14.

Apples.—While there is considerable difference in the adaptability of varieties to the different sections of California, those named in the list for district 12 have a wide range of adaptability and comprise the most important ones grown in district 14, aside from the Yellow Bellflower and Yellow Newtown, which are grown largely in the Pajaro Valley, and the Gravenstein, which is produced in large quantities about Sebastopol, in Sonoma County. These three varieties make up a large proportion of the commercial apple industry of California.

Pears.—Bartlett, Howell, Bosc, Anjou, Comice, Winter Nelis.

Peaches.—Alexander (w c), Triumph (y fc), Early Hale (w fc), Early Crawford (y f), Tuskena[1] (y c), Foster (y c), Decker (w f), Elberta (y f), Muir[2] (y f), McKevitt (w c), Late Crawford (y f), Lovell[2] (y f), Phillips[1] (y c), Salwey (y f).

Plums.—Yellow Egg, Washington, Jefferson, Grand Duke, Climax, Clyman, Wickson, Kelsey, Burbank, Satsuma.

Prunes.—Agen (French), Sugar, Imperial, Sergeant (*Robe de Sergeant*), Silver.

Cherries.—Chapman, Tartarian,[1] Napoleon (*Royal Ann*), Big, Republican,[3] Lambert.

Apricots.—Moorpark, Blenheim, Hemskirk, Royal, Tilton.

Figs.—Adriatic, Ischia, Mission, Marseillaise, Smyrna type.[4]

Japanese persimmons.—Goshio, Hachiya, Hyakume, Tanenashi, Yemon.

Raspberries.—Cuthbert (northern California), Surprise (southern California).

Blackberries.—Mammoth (self-sterile), Logan, Himalaya, Lawton (northern California), Crandall (southern California and Arizona).

Dewberry.—Gardenia.

Currant.—Perfection (northern coast section).

Gooseberry.—Oregon (northern coast section).

Strawberries.—Marshall (Fresno and northward), Oregon (Fresno and northward), Brandywine (southern California only), Arizona (in Arizona).

Grapes.—In this district the Vinifera, or Old World, varieties are grown nearly to the exclusion of American sorts. On account of the destructiveness of the phylloxera it is necessary to propagate the vines on stocks or roots that are resistant to that insect except in the case of the "direct producers," which are themselves resistant to the phylloxera.

The following varieties are named for district 14, and especially for California northward from a region somewhat south of Los Angeles: White—Alexandria, Green Hungarian, Palomino, Sultanina; red—Aramon, Flame Tokay, Barbarossa, Chasselas de Fontainbleau; black—Bellino, Gross Colman, Muscat Hamburg, Zinfandel.

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[1] Used largely for canning.

[2] Though used for canning and for shipping fresh, Muir and Lovell are of importance largely for drying.

[3] See comment on p. 29 concerning the self-sterility and intersterility of sweet cherry varieties.

[4] Several varieties of figs of the Smyrna type are grown in district 14. In parts of California they are being planted on a large commercial scale. Perhaps the Lob Ingir variety is the one of most importance. Smyrna figs require caprification in order to develop fruit; hence, caprifig trees must be planted with Smyrna figs. The amateur grower not otherwise informed should seek further advice before planting figs of this type.

FARMERS' BULLETINS WHICH HAVE A BEARING ON FRUIT GROWING FOR HOME USE.

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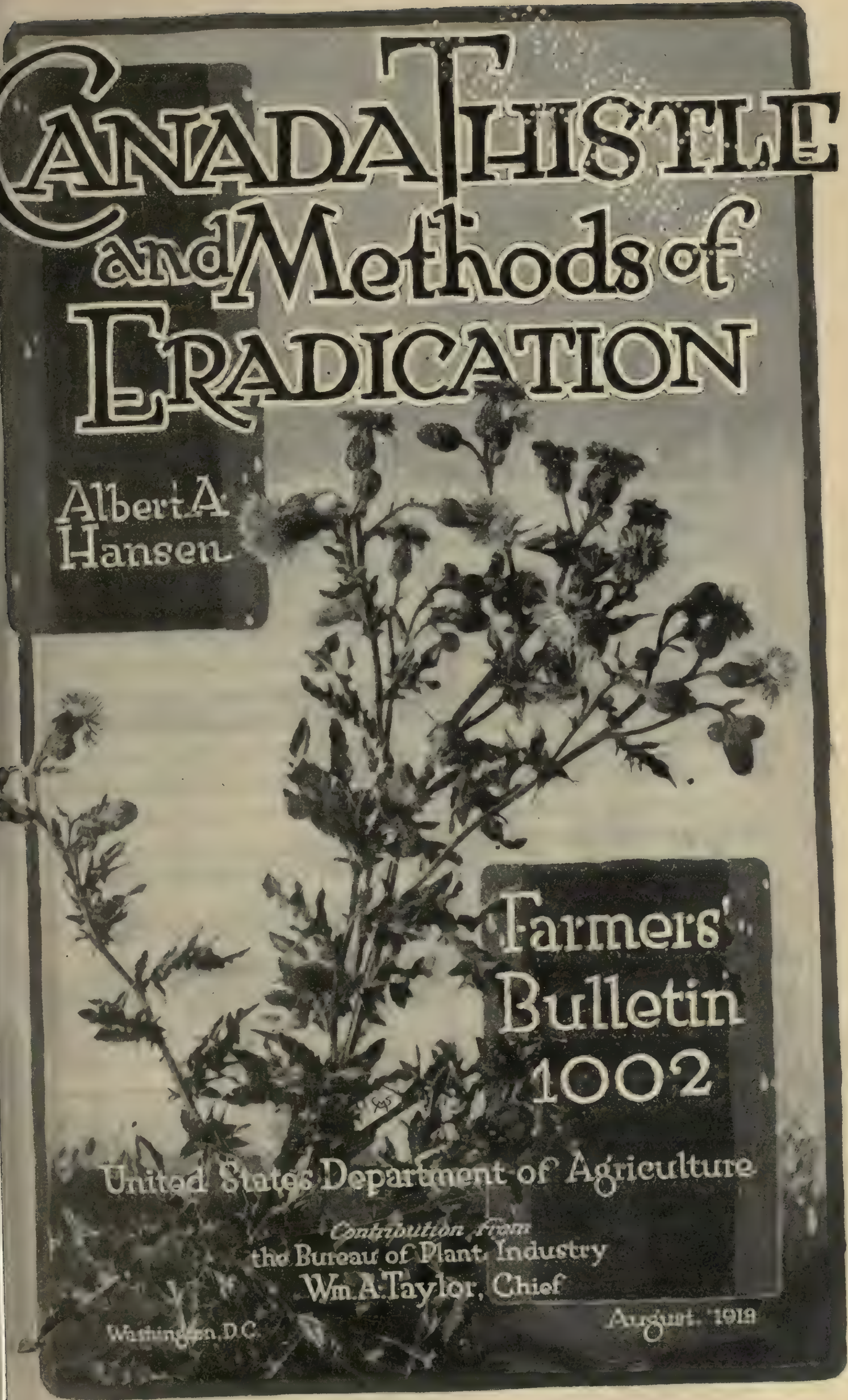
The City and Suburban Vegetable Garden. (Farmers' Bulletin 936.)
The Farm Garden in the North. (Farmers' Bulletin 937.)
Apple Bitter-Rot and Its Control. (Farmers' Bulletin 938.)
Preparation of Strawberries for Market. (Farmers' Bulletin 979.)
Farm and Home Drying of Fruits and Vegetables. (Farmers' Bulletin 984.)
Culture of the Logan Blackberry and Related Varieties. (Farmers' Bulletin 998.)
Soils of Massachusetts and Connecticut, with Especial Reference to Apples and Peaches. (Department Bulletin 140.)
Smyrna Fig Culture. (Department Bulletin 732.)



CANADA THISTLE and Methods of ERADICATION

Albert A.
Hansen

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1002

United States Department of Agriculture

Contribution from
the Bureau of Plant Industry
Wm. A. Taylor, Chief

Washington, D.C.
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THE CANADA THISTLE is not a native of Canada, but of Europe, whence it came both to Canada and the northern United States, where it has proved itself to be one of the worst farm weeds.

It is not common in the South, but is found occasionally in the mountains.

North of Pennsylvania it is disseminated widely by seeds, but also spreads by its creeping roots.

The seeds are scattered by the wind or distributed in infested hay or grain.

Its spread may be prevented and the plants destroyed by persistent cutting, preferably below the surface, before seed matures. This starves the roots.

Summer fallowing and clean cultivation with implements that cut the stalks beneath the surface will exterminate it.

But every plant must be destroyed or a new crop will soon be produced.

Small patches may be smothered by covering with boards, roofing paper, or similar material.

This bulletin illustrates and describes the pest and its manner of growth and gives tested methods of extermination.

CANADA THISTLE AND METHODS OF ERADICATION.

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DESCRIPTION OF THE CANADA THISTLE.

THE CANADA THISTLE[1] is an erect perennial, growing from 1 to 4 feet in height. The leaves are from 2 to 7 inches long, green on both sides, and are usually armed with numerous hard, slender, sharp-pointed spines. One variety of the Canada thistle, occurring in a few localities, has leaves practically free from spines. The leaves appear first as rosettes. If the rosette stage is formed early, the upright flowering stalk will appear during the same season, whereas if the rosette appears late the flowering stalk will not develop until the following season; the rosette meantime usually persists over winter. The imperfect-flowered and perfect-flowered plants are distinct, seed, of course, being formed on the perfect-flowered plants only.

The distinguishing features of the Canada thistle are (1) the deep-seated creeping roots, which grow in all directions, often to a length of a dozen feet or more, and send up new shoots at intervals (fig. 1), and (2) the small purplish flower heads, each about a half inch in diameter and smaller than the heads of most other thistles.

INTRODUCTION AND SPREAD OF THE PEST.

The Canada thistle is a native of Europe, where it has long been regarded as a vile weed, especially in the regions having climatic conditions similar to the northern half of the United States. It was regarded as a noxious plant even before the discovery of America.

It was probably first introduced into French America (now Canada) through the medium of impure farm seeds. Its very early introduction doubtless accounts for the statement of some of the earlier writers that the pest is native to Canada. It now occurs in Canada from British Columbia to Newfoundland.

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[1] Aside from "Canada thistle," this weed has been termed "thistles," "cursed thistle," "green thistle," "corn thistle," "California thistle," "creeping thistle," "prickly thistle," "way thistle," "hard thistle," and "soft field thistle."

Technically, the following names of the Canada thistle are synonymous: *Serratula arvensis* L., *Cirsium arvense* Scop., *Carduus arvensis* Robs., and *Cnicus arvensis* Hoffm. All of these names except the first are still of frequent scientific usage; the name most generally accepted, however, is *Cirsium arvense*.

The plant was introduced early into the New England States in impure seed, probably not from Canada, as has so often been stated, but direct from Europe. The first official recognition of its presence in New England was in the Vermont law of 1795. The weed was apparently introduced into New York State almost simultaneously with its appearance in New England, but it was not until 1813 that the New York Legislature took action against it.

It was introduced into Fauquier County, Va., during the Civil War, probably by means of baled hay sent to feed the horses of the Union Army. This vicinity still marks practically the southern limit of the Canada thistle range, and there is little danger of a further spread southward, since the climatic conditions in the South are not favorable for the growth of the plant. This belief is upheld by the fact that the plant failed to maintain itself after being introduced into Florida, Alabama, and Louisiana. However, it has found its way southward into the cooler sections of the Appalachian Mountain regions, where the conditions are favorable for its development. The weed has not as yet become troublesome in the southern Appalachian Mountain regions.

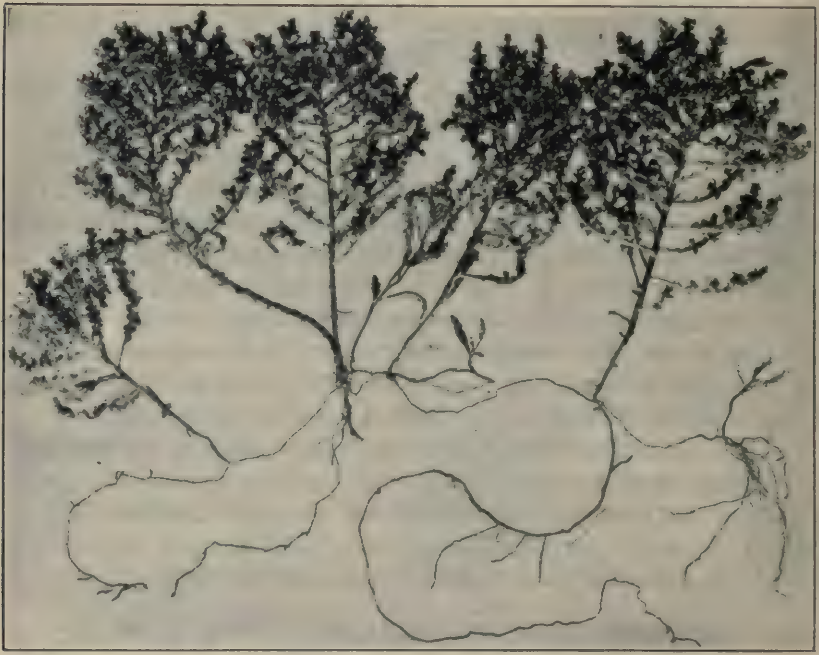

FIG. 1.—Several plants of the Canada thistle originating from a single creeping root and representing the growth of one season, starting with a seed planted in the spring. A portion only of the actual growth is here shown. Note the lack of surface roots exhibited by the individual plants.

The Canada thistle was not reported west of the Allegheny Mountains until later than 1835. At the present time it may be found in practically all the northern half of the United States, from the Atlantic to the Pacific (fig. 2). During recent years it has become increasingly troublesome in the grain-producing areas of the Northwest.

CONFUSION WITH OTHER PLANTS.

There are many plants with which the Canada thistle is likely to be confounded, the principal one being the bull thistle.[1] Both plants are noxious weeds and should be exterminated, but it is important to know which is being dealt with, since different control treatments are necessary. The following points of difference should be noted:

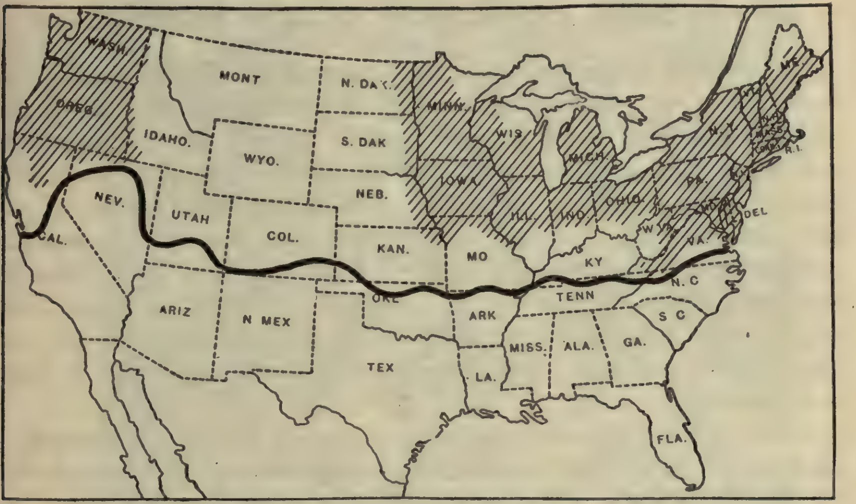

FIG. 2.—Map of the United States, showing the present distribution of the Canada thistle. The heavy line indicates the approximate southern boundary of the weed; the shaded area shows where the plant is most injurious.

(1) The head of the bull thistle is larger and of a different shape from that of the Canada thistle.

(2) The bull thistle is a biennial plant and does not possess the creeping roots so characteristic of the Canada thistle; hence the bull-thistle plants usually occur isolated in the field, whereas the Canada thistles grow typically in patches.

(3) The leaves of the bull thistle are larger and thicker than those of the Canada thistle.

(4) The main stem of the bull thistle possesses a tuft of roots close to the surface of the ground, which is not true of the Canada thistle.

(5) The mature plant of the bull thistle is larger and darker green in color than the mature plant of the Canada thistle.

(6) The main stem of the bull thistle is heavier than that of the Canada thistle.

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[1] *Cirsium lanceolatum.*

Various other thistles are often mistaken for the Canada thistle; each of them, however, possesses a taproot and lacks the creeping roots that distinguish the Canada thistle. Other plants locally known as the Canada thistle but bearing little or no resemblance to it are the horse nettle,[1] Russian thistle,[2] and spiny cocklebur,[3] all prickly plants. In California the milk thistle[4] was long mistaken for the Canada thistle, and legislation worded against the latter plant was enforced against the milk thistle until a lawsuit rectified the mistake.

Whenever there is doubt about the identity of the plant, specimens should be sent to the State agricultural experiment station or to the United States Department of Agriculture.

SEEDING HABIT AND METHODS OF SEED DISTRIBUTION.

The Canada thistle produces seed irregularly. It may seed abundantly one year and not at all the following season. There are regions, however, in which good seed is seldom, if ever, produced, and when seed is found only a small percentage of it is usually viable. If the southern boundary of Michigan were continued as a line east and west, it would constitute approximately the boundary south of which viable seed is rarely found. In New York State the weed produces seed frequently, whereas in Pennsylvania seeds are not ordinarily found. It has been observed that wherever cool, dry weather persists during the pollination period viable seed is likely to be produced.

Under ordinary farm conditions the seeds in the soil, especially those at or close to the surface, may germinate at any time during the growing season. The conditions at a depth greater than 3 to 4 inches are usually unfavorable to germination, but seeds buried at such depths may remain viable for some time, ready to germinate when brought nearer to the surface by cultivation.

In combating a weed such as the Canada thistle it is necessary to know the various methods by which the plant is disseminated, in order to guard against its further distribution on the farm. One of its principal methods of dissemination is by means of seeds, which are distributed in a variety of ways.

Distribution by the wind.—Each individual seed is equipped with a fringe of hairs known as a pappus, which, acting much like a tiny parachute, permits the seed to be carried by the wind.

As a single colony of plants may serve as a source of infestation for a considerable area of the surrounding territory, the eradication of the Canada thistle is as much a problem for the community as for the individual farmer and should be handled accordingly.

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[1] *Solanum carolinense.*

[2] *Salsola kali tenuifolius.*

[3] *Xanthium spinosum.*

[4] *Silybum marianum.*

Distribution in impure seed.—The commonest method by which the Canada thistle is introduced into new localities is by means of impure seed, principally that of grass and clover (fig. 3). This accounts in large part for the fact that 26 States have enacted laws directed against the pest. To permit the plant to mature seed is specifically forbidden by practically all of these laws. If the presence of Canada thistle seed is suspected in other seed, a sample should be sent either to the State agricultural experiment station or to the Seed Laboratory of the United States Department of Agriculture,[1] in order that the purity of the seed may be determined. This service is rendered

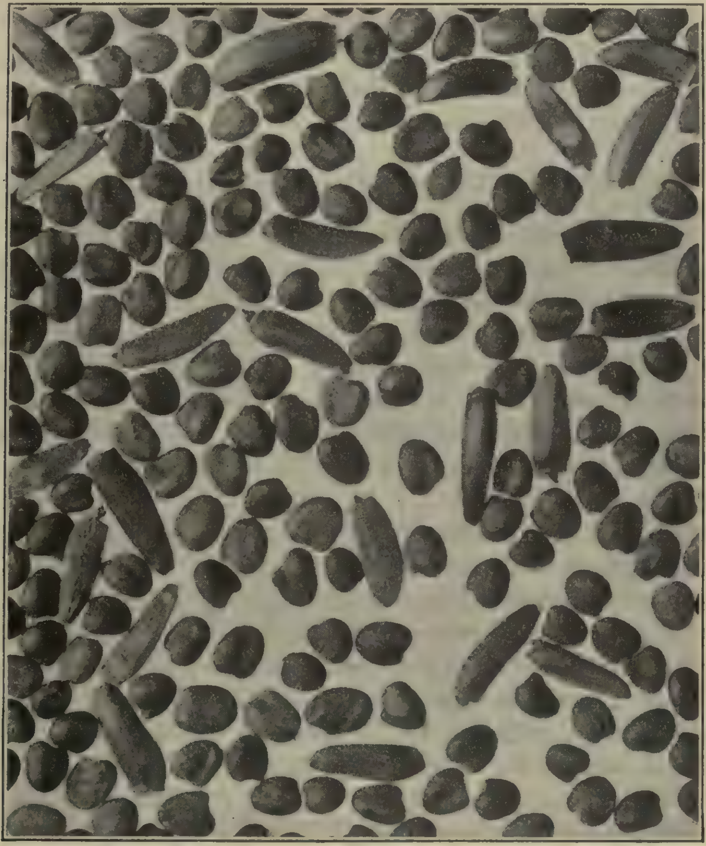

FIG. 3.—Impure clover seed containing a large percentage of the seed of the Canada thistle. The commonest method by which this weed is introduced is by means of impure seed.

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[1] In addition, seed samples may be submitted for analysis or identification to any of the following laboratories, maintained through the cooperation of the United States Department of Agriculture: Branch Seed-Testing Laboratory, Agricultural Experiment Station, Columbia, Mo.; Branch Seed-Testing Laboratory, Agricultural Experiment Station, Baton Rouge, La.; Branch Seed-Testing Laboratory, Oregon Agricultural College, Corvallis, Oreg.; Branch Seed-Testing Laboratory, Purdue University, La Fayette, Ind.; Branch Seed-Testing Laboratory, California Agricultural Experiment Station, Berkeley, Cal.

without cost. The seeds most commonly containing Canada thistle seed are the clovers, timothy, the small grains, and Canada bluegrass.

Miscellaneous methods of distribution.—Seeds may be disseminated by means of farm machinery, such as thrashing machines. These machines should always be cleaned before being moved from one farm to another.

The weed is sometimes transported long distances in hay or in packing around crockery, nursery stock, etc. Railroads and other transportation lines as well as the coats of animals are more or less important distributing agencies.

CHARACTER OF UNDERGROUND PARTS.

The Canada thistle possesses running roots which penetrate the ground often 15 inches or more, the depth being largely dependent on the amount of cultivation, the character of the soil, and the depth of the water table. Cultivation serves to increase the depth to which these roots extend. On land untilled for a long period of years the roots usually are close to the surface. The character of the soil is also important in determining the depth to which the underground parts penetrate, since the roots will normally grow deepest in a mellow soil.

A single root may produce many shoots, which appear at different times throughout the growing season (fig. 1). The growth of the roots serves effectively to spread the pest over considerable areas of ground. Furthermore, plows and other implements may break the roots into pieces, each of which may produce a new plant and by so doing start a new area of infestation. The roots also divide by natural means, usually due to the decay of the older parts. During the autumn most of the nutriment contained in the stem and leaves is transferred to the underground parts, and the plants die back when frost comes, the vertical root being killed to a depth of 5 to 10 inches. This suggests that cutting the plants in the fall is of little practical value, since extra nutrition is then stored in the deep-seated roots.

ERADICATION OF THE WEED.

In the eradication of the Canada thistle there are many factors to consider, one of the most important of which is the weather. The weed is much easier to eradicate during droughts than during wet weather. The operations of plowing, harrowing, and cultivating directed against the thistle should never be undertaken when the land is wet.

Control methods for the Canada thistle should aim at complete eradication; if only a few plants survive, they are usually sufficient to cause serious reinfestation in a comparatively short time. To secure complete eradication the underground parts must be completely killed, since it is principally by these that the pest lives over from year to year. The most practical method of exterminating these underground parts is to starve them out by frequently destroying all the top growth of the plants. Since plants can assimilate food only by the aid of green leaves, the frequent cutting of the tops uses up food stored in the fleshy roots.

ERADICATION ON SMALL AREAS.

The importance of eradicating the Canada thistle on small areas can hardly be overestimated, since the pest spreads readily, and a small patch may be the direct cause of infesting an entire farm almost before the farmer is aware of the presence of the weed.

There are several methods by which small-area infestations may be eradicated, the commonest and most practical of which is the frequent cutting of the green growth by means of a hoe, spud, or some other cutting instrument. It is desirable to sever the stems a few inches below the surface of the ground. This will cause the eventual starvation of the weed, but perseverance is needed to insure success. If the patch is very small, it is sometimes practicable to dig out the plants, roots and all.

Smothering is practicable on limited areas. Cover the infested spots with tar, building, or some other kind of heavy paper, which should be laid with overlapping edges well weighted down with earth or stones so that no light can penetrate. At least one entire season will be necessary for success.

Covering with coatings of straw, hay, sawdust, and various other things has not proved uniformly successful, because the thistle plants will grow through the covering. Small patches may be eradicated by covering them with at least 18 inches of manure for a minimum period of a year. A helpful practice is to locate the thrashing machine so that the straw pile will cover a patch of Canada thistle, but this method is successful only when the straw pile is large enough to extend some distance beyond the edge of the thistle patch.

The use of chemical plant poisons is practicable on small areas. The application of crude carbolic acid, hot brine, sulphuric acid, kerosene, or of strong solutions of caustic soda or arsenite of soda to the newly cut surfaces has been successful, but the expense is heavy. Arsenite of soda is a deadly poison and must not be used in places to which live stock have access. Crude carbolic acid and kerosene are best applied by means of an ordinary machinist's oil can. Salt persistently applied to the newly cut surfaces will eradicate thistles.

Canada thistles growing in waste places and along fence rows, railways, and roadways should never be allowed to mature seed and thus act as a constant menace to surrounding lands. Such infestations should be eradicated. If the eradication is not complete, the thistles should be mowed at least twice a year, to prevent seeding.

ERADICATION ON LARGE AREAS.

Two principal plans of eradication are applicable on large areas. It is always well to keep in mind that eradication is secured only through the starvation of the roots by the removal of top growth. Too often the work is neglected when extermination has been almost attained. Given the least opportunity, the Canada thistle will reestablish itself very rapidly.

The thistle grows best on rich, loamy, moist soils; hence thistle-infested land is usually well worth reclaiming.

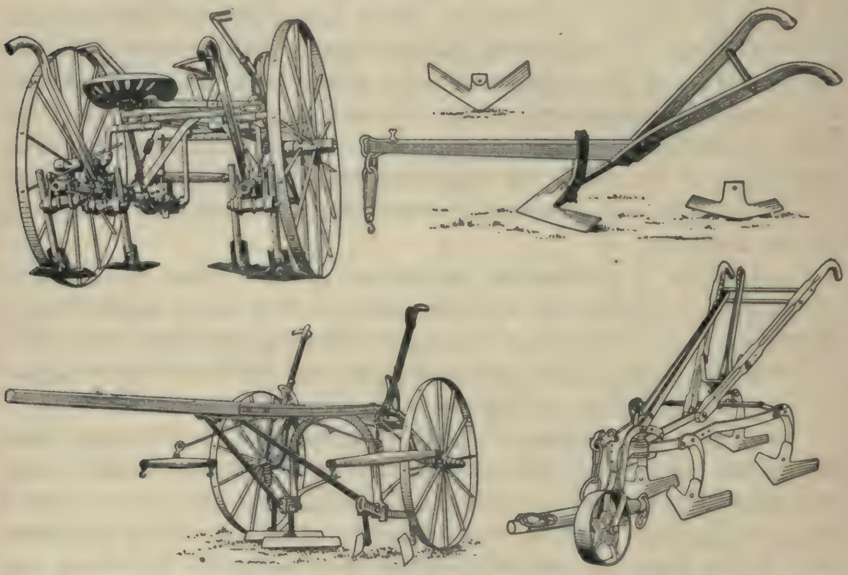

FIG. 4.—Various types of cultivators equipped with knives or sweeps that are effective in cutting off the stems of perennial weeds below the soil surface.

Clean cultivation with a crop.—This method has the advantage of killing the weeds without losing the use of the land while so doing.

In a well-prepared seed bed, plant a cultivated crop, such as corn, using the checkrow system, if practicable. Cultivate thoroughly, in order to prevent the development of thistle leaves. The shoots must be cut off no less than six or eight times during the season if complete success is to be attained. It will be necessary to go through the crop occasionally with a hand hoe in order to clean out the plants growing so close to the corn that they escaped the cultivator.

The best implement for cultivation is the sweep or knife type of cultivator (fig. 4). The shovel and tooth types of harrows and cultivators, so commonly used in the East, are not so efficient, since they allow much of the top growth of the thistles to slip through. Special sweep or knife cutting implements may be used, or separate sweeps may be purchased and attached to the cultivator in place of the shovels. Sweeps are adapted to loose, friable soils only; their use should not be attempted in cloddy or stony soils. After it becomes impracticable to cultivate longer, any thistle tops which appear should be cut back with a hoe until frost.

A single season of careful, painstaking work will frequently serve to exterminate the thistle; less time is really required than is generally believed, provided the work is thoroughly done.

The following season another cultivated crop should insure the success of the plan.

Summer fallowing followed by a cultivated crop.—Like the plan of eradication described on page 10, summer fallowing followed by a cultivated crop keeps in check the top growth and starves the root system, thereby eradicating the pest. The plan is well suited for large areas.

Just previous to the blossoming of the thistle, which is the stage at which the plant is most easily destroyed, plow shallow. During the remainder of the growing season cultivate with a disk harrow or with sweeps at intervals often enough to prevent a maximum of 3 inches of thistle growth at any time. Continue this practice until fall. If the thistle roots are sufficiently near the surface, plow deep enough to expose them to the effects of winter frosts.

The following spring plant the land to a cultivated crop, such as corn, and give careful cultivation to see that no thistle tops survive. The cultivated crop will enable one to destroy any thistles that may appear. The thistles should be entirely eradicated when the crop is matured.

ERADICATION METHODS IN PRACTICE.

The methods of eradication previously outlined may be illustrated by the experience of a farmer who purchased a farm in the corn belt. The land was so badly infested with Canada thistles that it was obtained at a very low price. In cooperation with the Department of Agriculture he outlined a campaign against the thistles, having in mind the single object of keeping down the top growth of the weeds. He divided his farm into three fields of approximately 25 acres each.

Field 1.—In field 1, containing about 3 acres of thistles, he planted corn in checkrows, cultivating with an implement on which the ordinary shovels had been replaced with 9-inch sweeps, the edges of which were kept well sharpened.

When the corn was laid by, the use of the sweeps ceased, and handwork with a hoe was substituted. At first, weekly cuttings were necessary, chopping the thistles off well below the surface, but the intervals between which chopping was necessary became longer and longer as the season advanced. This handwork was done at odd times, though systematically carried out. After the removal of the corn crop the entire field was plowed. The following spring another crop of corn was planted, but no thistles appeared. The pest was thus eradicated in a single season because a systematic plan was strictly followed. The extra labor involved was small compared with the results obtained.

Success should not always be looked for in a single season, since unfavorable weather conditions may delay eradication, but extermination of the Canada thistle is possible by the effort of one season only.

Field 2.—Field 2 was pastured throughout the first season. An area of about 2 acres was thickly set with the thistles and numerous small isolated patches were scattered over the remainder of the field. In June, just previous to flowering, the thistles in the small isolated patches were cut below the surface of the ground with a hoe. This practice was continued until fall at intervals frequent enough to prevent more than 3 inches of thistle growth from appearing. The handwork was heaviest at first, diminishing considerably as the season advanced. The following year the land was plowed, planted to corn, and given careful cultivation. At the end of this second season the Canada thistles had been completely exterminated.

The heavily infested area was so thickly covered with thistle growth that the plan practiced on the remainder of the field was hardly practicable; hence a different treatment was given. These 2 acres were plowed in June, just previous to the blossoming period of the thistle. After plowing, the land was disked. The disking was continued at intervals frequent enough to keep down the top growth of the thistles throughout the remainder of the growing season. Two diskings a week were necessary at first, but as the season advanced, this number was gradually reduced in proportion to the loss of vigor of the thistles, until toward the end of the summer one disking every other week served the purpose. The following year no crop was planted, but the natural growth contained no evidence of the thistle. The work had been so thoroughly done that the weed was completely eradicated in a single season of effort. It is the best practice, however, to follow a season of fallowing with a cultivated crop, in order to catch any stray thistle plants which may survive the fallow.

Field 3.—When the experiment started, field 3 was sown to oats. In the most heavily infested patches the thistles were cut, along with the oats, just previous to the blossoming of the weed. Throughout the remainder of the field all the thistle plants were cut below the crown in June, so none was allowed to mature seed. The oat crop was followed by winter wheat, but in this instance the wheat failed because of weather conditions; hence the field was put into grass and clover the following season. In this grass crop the most heavily infested spots were cut frequently, grass and all, while in the remainder of the field handwork was necessary to keep back the thistle growth. A clean hay crop was the result. All the work up to this stage was performed with the object of weakening the vitality of the thistle and to prevent it from seeding, while in so doing clean crops were produced. This treatment kept the weed in check until the field was ready for a cultivated crop to eradicate the thistles.

Why success was attained.—Success in the case of the three fields just cited was due to (1) the outlining of a careful plan of attack, (2) faithful adherence to the plan, and (3) the use of proper implements.

It should be noted that the initial work was the heaviest; as the season advanced the labor became proportionately lighter. Perhaps the principal reason for success was the perseverance with which the work was done. When the corn crop was laid by, for instance, the work with the weed was continued, giving it no chance to grow and replenish the depleted stock of food stored in the roots. The handwork with the hoe was regarded as just as necessary as any other farm work.

MINOR METHODS OF ERADICATION.

Many minor methods of eradication have proved successful, and some suggestions that should be helpful follow.

Smothering.—The Canada thistle does not withstand shade well; hence smothering crops are sometimes successful. The best of these crops appears to be hemp, while millet, buckwheat, alfalfa, sorghum, the grasses, the small grains, and field peas are all helpful. Hemp is especially to be recommended in sections where it can be grown successfully. Alfalfa has been found to be very useful, because of the frequent mowing which this crop receives. During years of prolific thistle-seed production winter grains usually kill a large number of the thistle seedlings. A rotation consisting of a cultivated crop followed by a winter cover crop, which in turn is followed by a smother crop, is perhaps the best method of utilizing smother crops in combating the thistle. Thus in several parts of the country corn planted in checkrows is followed by rye as a winter crop. The rye is cut for hay, after which the land is planted to alfalfa. Very few Canada thistles are able to survive this rotation.

Years of effort are usually necessary to clear the land of the thistle by the smothering plan, and sometimes only partial success is attained. Smother crops are generally successful only upon relatively rich soils. Smothering will be found most useful when following a cultivated crop, thus killing the thistles which survived cultivation.

Grazing.—Normally few, if any, animals will feed upon the Canada thistle, although if no other forage is available sheep and goats may be forced to graze the weed. It is significant that thistles are rarely found upon land grazed by either sheep or goats. The salting of numerous small thistle plants will greatly facilitate eradication, since it will aid in inducing the animals to overcome their dislike for the prickly pest. Close grazing will have the effect of starving out the underground parts.

Spraying with chemical plant poisons.—As a practical method of eradication under ordinary farm conditions the much-advertised plan of spraying with chemicals is not to be advocated. It may prove useful, however, where the thistle grows in rocky situations, where the weed often infests stone fences in such a manner as to render eradication by any means other than spraying a very difficult matter. Under these conditions it may prove profitable to spray the plants with a solution of 1 pound of arsenite of soda dissolved in 6 gallons of water, using a hand sprayer for the purpose. The plants should be sprayed first when about half grown and again when the new growth has attained a height of about 6 inches. A third spraying will usually be necessary when the young thistles are about 6 inches high.

HELPFUL SUGGESTIONS.

Several suggestions regarding the handling of the Canada thistle may prove helpful.

The thistle typically occurs in isolated patches. It is advisable not to plow through such patches, since by so doing pieces of the roots will undoubtedly be scattered to many parts of the field, thus increasing the area of infestation. A small piece of root, not more than a quarter of an inch in length, is sufficient to start a new plant. Small patches should be treated by the methods previously explained. If, however, it is necessary to plow through a thistle patch, care should be taken to clean the plow thoroughly afterwards, in order to avoid the danger of scattering the root pieces.

Grain fields heavily infested with Canada thistles may be cut for hay profitably while green rather than allow the thistle seeds to mature. Hay fields containing a large quantity of thistles should be cut early, as this will prevent the thistles from going to seed. This is especially important in the northern range of the thistle, where it is known that it frequently produces seeds.

Topping thistles in grain fields is often advisable just before the thistles commence to head; the blossom heads at that stage stand above the surrounding grain. Removing these heads will retard the growth of the thistles so that few, if any, will mature seed before the removal of the grain. The work can be done rather rapidly with knives or sickles. This method is especially applicable where only a few patches of thistles are present.

Manure may become infested with the seeds of the Canada thistle by means of infested hay or stock feed. It is possible for thistle seeds to pass through the digestive tracts of animals and retain their vitality. In the case of hay, the seeds may get into the manure either by passing through the digestive tract or by dropping from infested hay directly into the manure.

Screenings from grain grown in infested areas should be ground fine before being fed to stock. This practice not only kills the Canada thistle seed, but in addition kills many other noxious weed seeds.

If infested hay or stock feed has been used, composting for a period of not less than three months will destroy the thistle seed together with many other weed seeds that are in the manure. In case the farm is thistle free, this plan will insure safety. Whether the manure should be composted or not is a problem to be solved by the individual.

In some sections of the country the Canada thistle is infested with a rust[1] which prevents many seeds from maturing. It has been suggested that the weed can be controlled by introducing and encouraging the spread of this disease, but all experiments to test this plan so far have failed.

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[1] *Puccinia suaveolens.*

HOW TO CONTROL BILLBUGS
DESTRUCTIVE TO
CEREAL AND FORAGE CROPS

A. F. SATTERTHWAIT
Scientific Assistant
Cereal and Forage Insect Investigations

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Contribution from the Bureau of Entomology
L. O. HOWARD, Chief

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BILLBUGS DESTROY OR INJURE corn, wheat, rye, barley, oats, timothy, blue grass, Bermuda grass, Johnson grass, rice, sugar cane, peanuts, and chufa. The best-known form of injury is corn leaf perforation.

The principal losses are caused by combined injury by the adult billbugs and their young or larvæ. The heaviest losses are probably in hay and pasturage.

Billbugs have only one generation yearly and are generally dependent on grass sods or wild sedges and rushes. Corn, sugar cane, chufa, and timothy probably are our only crops in which they can perpetuate themselves within the plant tissues.

Clean cultivation, especially the complete elimination of wild sedges and rushes, suitable crop rotations, summer or early fall breaking of cultivated or infested wild sods, early planting of crops menaced by billbugs, and the protection of birds, especially ground feeders, including the bobwhite and the shore birds, are efficient methods for preventing crop losses by billbugs.

Parasites are valuable natural checks, but their work follows, rather than prevents, crop loss. Therefore, do not rely upon them to the neglect of control measures, or the results may be disastrous.

Cooperate with your neighbors in active measures for destroying the billbugs.

HOW TO CONTROL BILLBUGS DESTRUCTIVE TO CEREAL AND FORAGE CROPS.

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HOW BILLBUGS INJURE CORN, GRAINS, AND GRASSES.

THE CONTROL of billbugs destructive to corn, wheat, and other cereals and to forage plants is a matter of vital importance to many farmers throughout the country. The presence of the billbugs in cornfields usually is first made known by the appearance of rows of holes in the corn leaves. These holes are made by the beetle before the unrolling of the leaf. The principal injuries to this crop occur in the spring when the beetle reduces the stand or shortens the season for replanted corn or both.

Injuries to cultivated grasses and to small grains probably are much greater than to corn, although unnoticed except in extreme cases.

The havoc wrought by the large, swamp-grass infesting billbugs shows the need of caution in planting corn near marshes, especially on recently drained land, where bullrushes, sedges, and other coarse, wild grasses grow. To bring this ground into corn production without loss, precede the corn planting by one year's planting of crops which are distasteful to billbugs. Billbugs in the adult and larva stages feed normally on the same species of plant, and do not usually travel much.

Over a large area showing serious infestation in Illinois it was found that billbugs injured 50 to 75 per cent of the timothy corms in certain fields, whereas in the younger, 2-year-old timothy sods only

10 to 20 per cent of the corms were injured. Of infested corn hills, 33 per cent failed to produce ears, some fields yielding only 20 to 45 bushels per acre where the normal yield was 80 bushels.

The larger billbugs may be sufficiently abundant in reclaimed swamp land to destroy two or three complete replantings of corn, while the smaller kinds in timothy fields turned down for corn rarely destroy more than about 50 per cent of the first replanting, and do little subsequent injury.

The losses in corn usually are caused by the adults, except in the case of the maize billbug and the "curlew bug," the injuries of which are caused by both adults and grubs. Each transverse row of holes in a corn leaf (fig. 1) results from a single puncture made by a beetle through the layers of a rolled-up leaf. The corn plants may be deformed in two ways: First, the perforated leaf, by falling or twisting, may interfere with the growth of the following leaves (fig. 2); and, second, injury low down on the stalk may cause sprouting or suckering (fig. 3). Loss by the former type of injury may be reduced by clipping off promptly the deformed leaf, but loss by the latter type is irreparable.

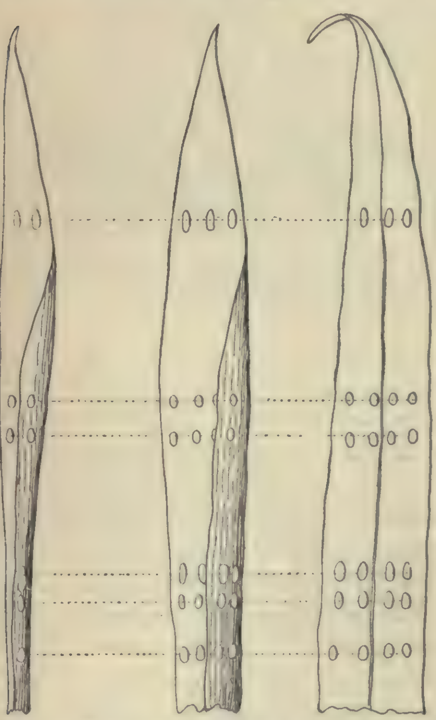

Fig. 1.—Diagrammatic figures showing rolled corn leaf with billbug punctures in it and the same leaf unrolled to show the characteristic row of holes and how they are produced.

While injury to corn usually takes place early, damage may appear after the corn is 4 feet high.

Injury by adults to blue grass appears in the stem between the roots and the second joint, as numerous punctures, ragged as if the fibers were torn apart, but often there is no evidence of feeding by the beetle on the soft central tissue, or even of disturbance of this tissue.

Other losses are caused by extensive feeding of the young or grubs on the fibrous roots of grasses and grains, within timothy corms, and to some extent within the stems of small grains (figs. 4 and 23). Injury to small grains by the grubs occasionally is shown as bleached-out heads with shriveled or no kernels, areas in margins of fields having from 10 to 68 per cent of the heads white on this account.

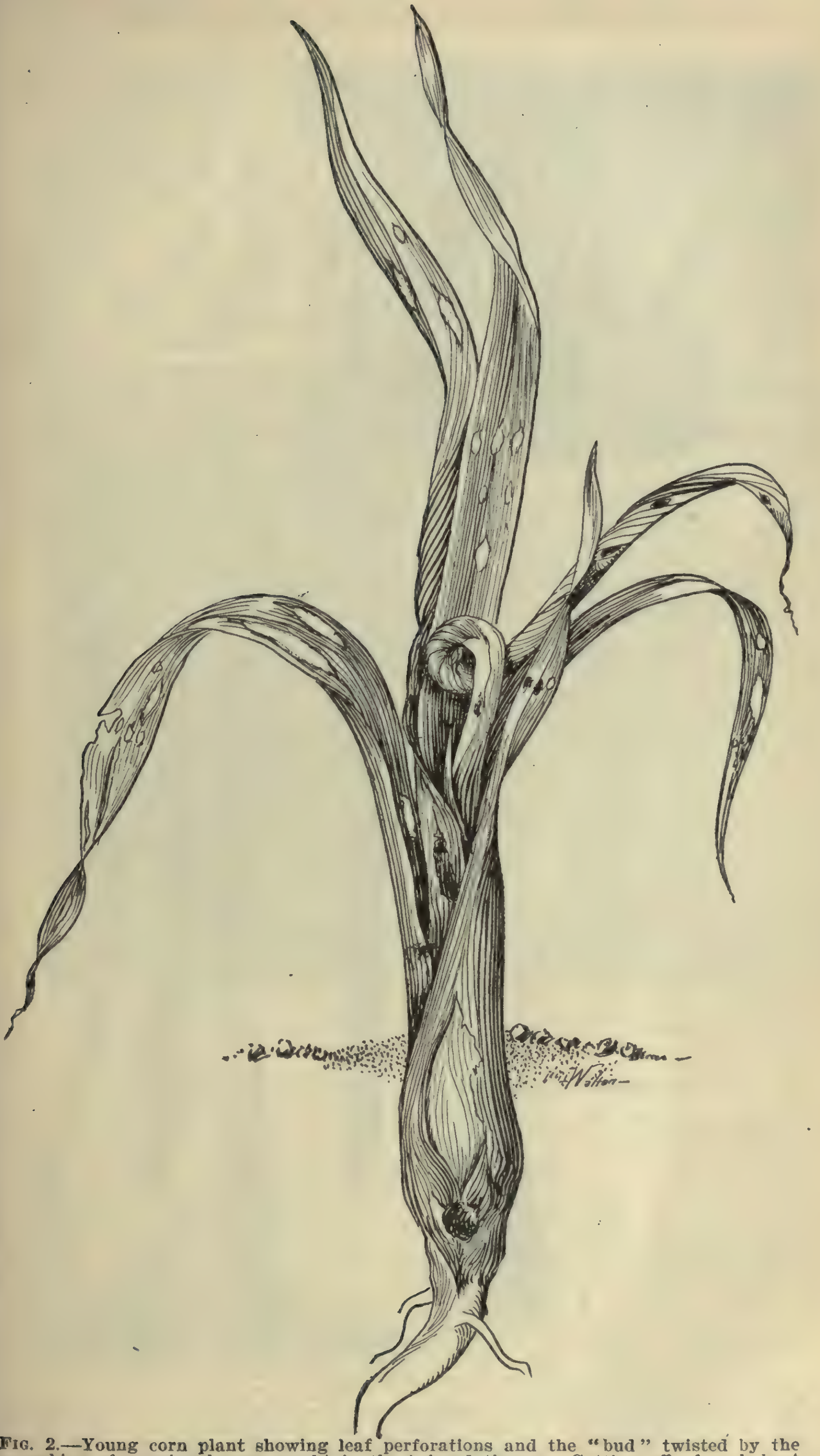

Fig. 2.—Young corn plant showing leaf perforations and the "bud" twisted by the pushing of growing leaves caught in the injured tissues. Cutting off of such bent or twisted buds promptly is sometimes profitable.

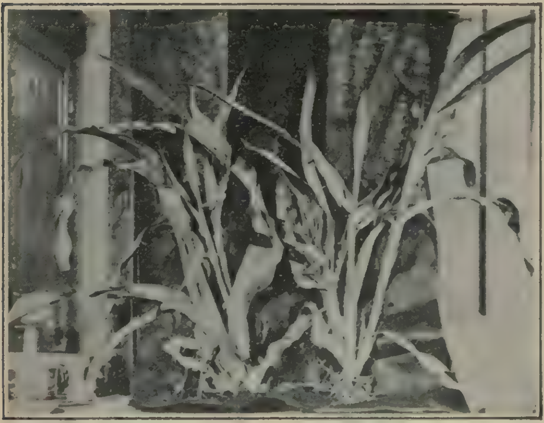

FIG. 3.—Corn plants crippled irreparably by the maize billbug. Plants injured thus spend their remaining vitality in suckering profusely and can not produce an ear.

More commonly injury is indicated by breakage of the straw as harvest approaches (fig.5). This breakage resembles the "lodging" of the straw where the Hessian fly has caused injury in the spring. The manner of work, however, is different. The fly makes a dent in the outside wall without chewing the stem fiber, but the billbug grubs eat away the interior of the stem so that the remaining shell crushes with the weight of the top or with the wind. These bored stems are left packed with débris by the billbug grubs.

Grub injury has been observed in blue-grass stems as a burrow either upward or downward from the egg cell. These burrows occasionally are as much as 15 or 18 inches in length. When too large to continue in the original stems the grubs go down to the root stocks and fibrous rootlets to complete their growth.

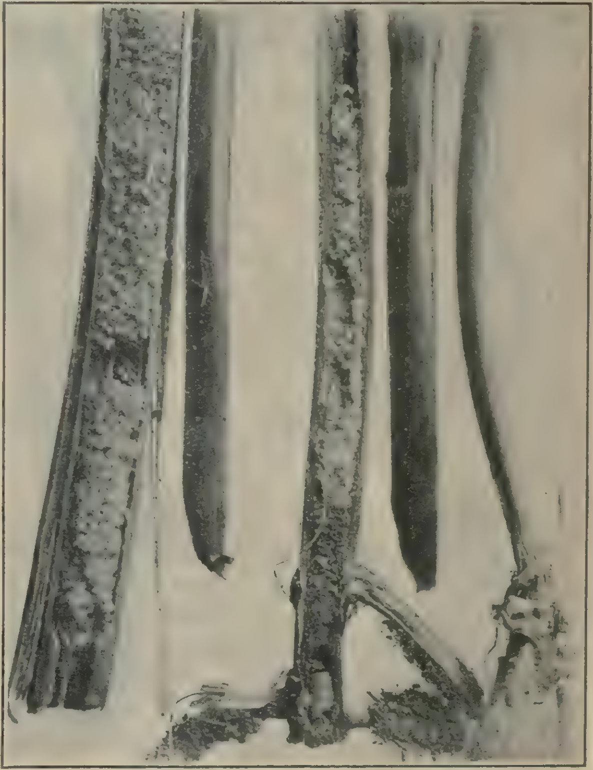

FIG. 4.—Work of the blue-grass billbug, showing punctures in the unsplit straws where fibers are frayed, and the frass-packed excavations in the split stems. A larva is shown in the base of the central stem.

GENERAL DESCRIPTION OF BILLBUGS.

The parents of the billbug grubs are beetles varying from one-fifth to about an inch in length, each of which possesses a long snout or bill which carries at its tip a pair of strong jaws with which the beetle chews its food and bores the cells in which its eggs are laid. The beetles have extremely hard shells, which often are more or less pitted and ribbed along the back. They vary in color from clay yellow through reddish brown to jet black, but are often so covered with the soil in which they have been boring that they resemble small animated lumps of earth. When disturbed a beetle will draw in its legs, fold its bill upon the breast, and remain quiet for some time.

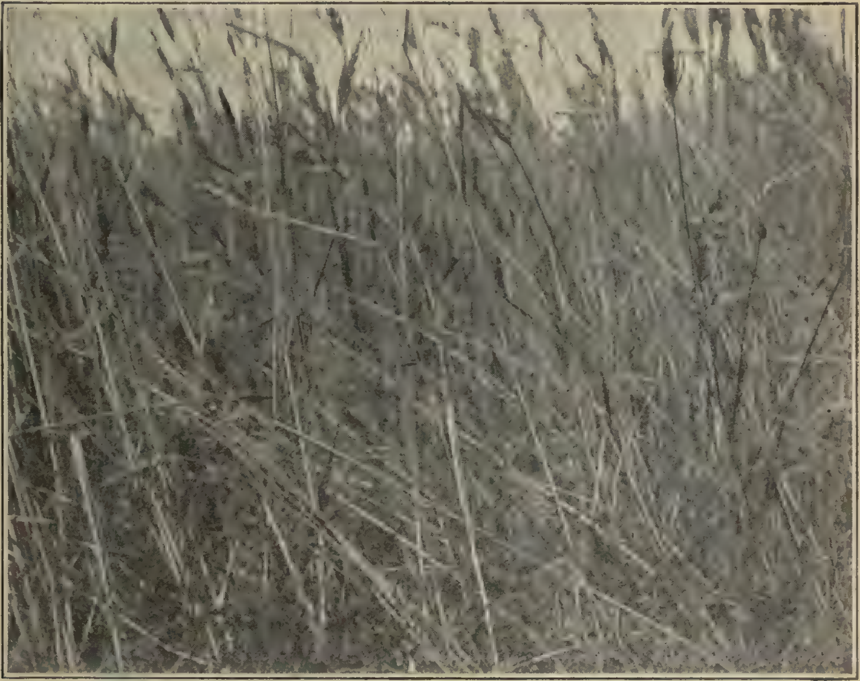

FIG. 5.—Wheat falling and lodging as a result of infestation by the Phœnix billbug, the work of which is done at the base of the stems, like the work of the blue-grass billbug.

LIFE HISTORY OF BILLBUGS IN GENERAL.

Billbugs in general require one year in which to complete their development, as follows: The adult female which has hibernated emerges in the spring, feeds, mates, and lays eggs. Usually it cuts a cell in a plant stem in which to deposit its egg (figs. 6, 7, 15, *b*, and 18, *b*) and egg-laying covers a period of about two months during late spring and early summer. From 4 to 15 days after the eggs are laid the grub hatches. This grub (figs. 4, 8, and 19) is a small, white, maggot-like worm with hard brown or yellow head, and looks very much like the maggots one often discovers upon biting into a chestnut. It feeds for several weeks, and when fully fed changes to the pupa or resting stage (figs. 9, 15, 18, *c*, and 20). Several days afterwards the pupa changes to an adult (figs. 10–14, 17, 18, *c*, 21, and 22), which may pass the winter in the pupal cell or may come forth and lead an active life for some time before becoming dormant for the winter.

BLUE-GRASS BILLBUG.[1]

The blue-grass billbug (fig. 10) is one-fourth to five-sixteenths of an inch in length. It is a widely distributed upland species, usually infesting timothy and blue grass, but often injuring wheat and occasionally oats, barley, and rye, and probably several wild grasses. The adult or beetle works frequently on corn planted on spring-plowed old sod, dwarfing it more frequently than killing it. The injury caused by grubs in blue-grass is seen frequently, but the potential injury is the unseen, widespread cutting of grass root-bulbs and rootlets, resulting in an annual hay and pasture loss and premature failure of the sod.

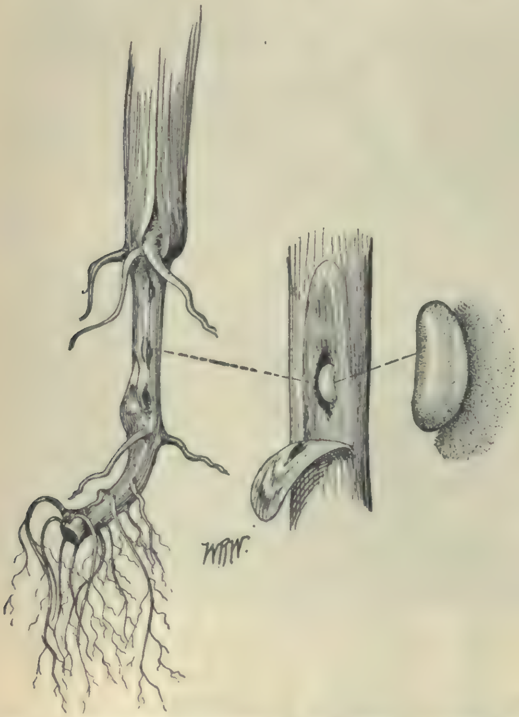

Fig. 6.—Egg punctures of the Phœnix billbug in base of wheat plant, with egg shown in cell in opened stem, and with egg further magnified.

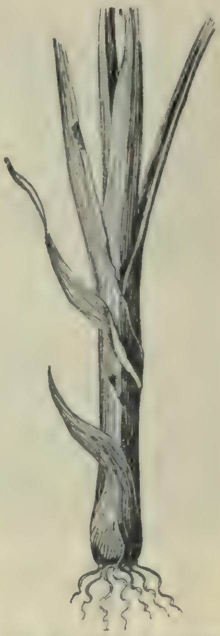

Fig. 7.—Egg or feeding puncture, probably of the "curlew bug," in stem of sedge.

When the grub works in timothy it may excavate the stem for about 3 inches at the base, or the corm, or both, or it may eat the root fibers and corm from beneath. The hollowed corm often may be found packed with the castings of the grub, which are called "frass."

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[1] *Sphenophorus parvulus* Gyllenhal.

and where infestation is serious the excavated ends of a large percentage of the corms can be seen by pulling up a timothy sod when the soil is dry and examining it from beneath. Pupation occurs either in the corms or in the soil. In attacking rye, the grub eats out completely the substance of the nearly solid stem (fig. 4) up to the second joint, then goes to the roots, and sometimes destroys all the roots of a whole stool. The larval period approximates 23 days, the pupal period about 8 days in midsummer, and the entire period from laying of the egg to the appearance of the beetle approximates 45 days. This billbug is able to remain submerged in water for days without injury.

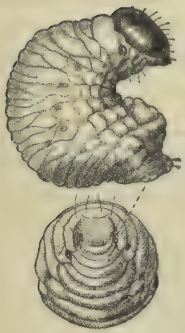

FIG. 8.—Grub of maize billbug. Twice natural size. (Kelly.)

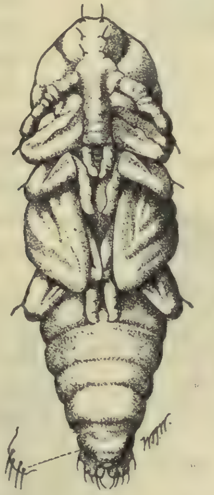

FIG. 9.—Pupa of the Y-marked billbug. Greatly enlarged.

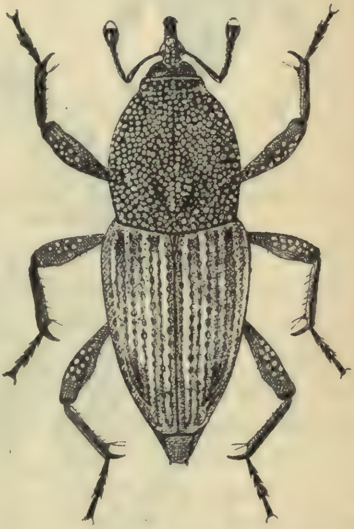

FIG. 10.—Adult blue-grass billbug. Much enlarged. (Chittenden, unpublished.)

The blue-grass billbug probably is distributed throughout the country; at least it is known from Canada to Florida and Texas and from the Atlantic coast to South Dakota.

CORN BILLBUG.[1]

The corn billbug (fig. 11) has habits and life history practically the same as those of the blue-grass billbug, but it is larger and more robust. It often occurs in the same timothy clusters with the blue-grass billbug, but the blue-grass billbug prefers the higher portions of the field and the corn billbug the lower portions.

This billbug has been known to destroy the first and second plantings of corn and to injure the third on a spring-plowed, upland, 13-

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[1] *Sphenophorus zeae* Walsh.

year-old timothy meadow, remote from either stream or swamp. It cripples much of the corn by making it sucker and fail to produce ears. This species is charged with being one of the prime causes of the early failure of meadows, the injury resulting from the work of both grubs and adults, but more often the former.

While this usually appears to be an upland species, great numbers frequently have been collected in drift along overflowed streams. It occurs from Massachusetts and Michigan to Florida and Kansas and probably farther west and southwest.

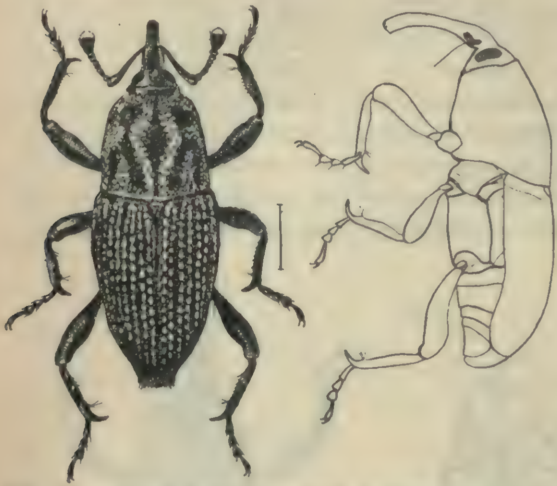

FIG. 11.—Adult corn billbug. Much enlarged. (Chittenden, unpublished.)

The life cycle of the corn billbug, from laying of egg to issuing of adult, consumes about 52 days. The egg stage lasts approximately 9 days, the grub stage frequently about 38 days, and the pupa stage approximately a week.

In the field eggs are laid promiscuously on a leaf near the base of its sheath, on or in the center of shoots, and in cells excavated in the timothy corms.

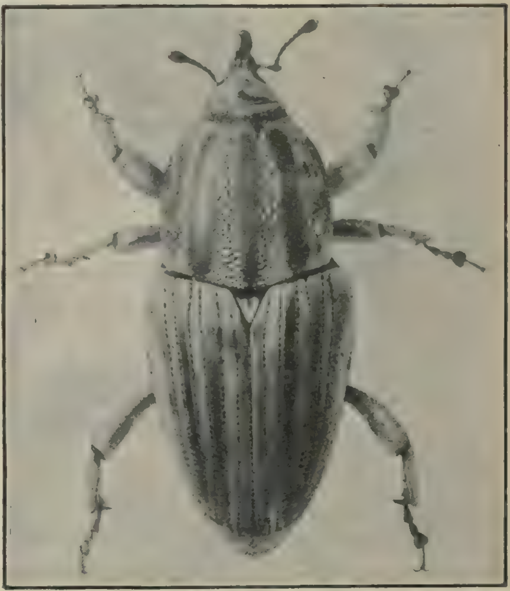

FIG. 12.—Clay-colored billbug. Much enlarged. (Walton.)

CLAY-COLORED BILLBUG.[1]

The clay-colored billbug (fig. 12) is a large species, measuring more than half an inch in length. It is a swamp-inhabiting insect and, in Illinois and Indiana, has a life history about as follows: The egg is laid in the stalk about 4 inches above the young bulb, egg laying taking place from May till the 1st of August. The grub bores down the stem and to the old bulbs, even passing through a fourth inch of soil to reach the old bulb (fig. 13). Pupation takes place within the larval excavations in the bulbs, and adults issue by August 21 and remain in the pupal cell over winter, appearing above the ground by the time the corn is up in the spring.

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[1] *Sphenophorus aequalis* Gyllenhal.

Injury by the clay-colored billbug to corn is wrought in the same manner as by the others, but instead of causing it to sucker it usually kills the plant attacked.

This species occurs throughout the United States from Canada to Arizona and eastward to the Atlantic coast. The adult has been found feeding on corn, millet, foxtail,[1] club rush or dark green bulrush,[2] river bulrush,[3] bristly nutgrass or straw-colored Cyperus,[4] and common reed grass,[5] and the grubs breeding in rushes, sedges, and reeds.

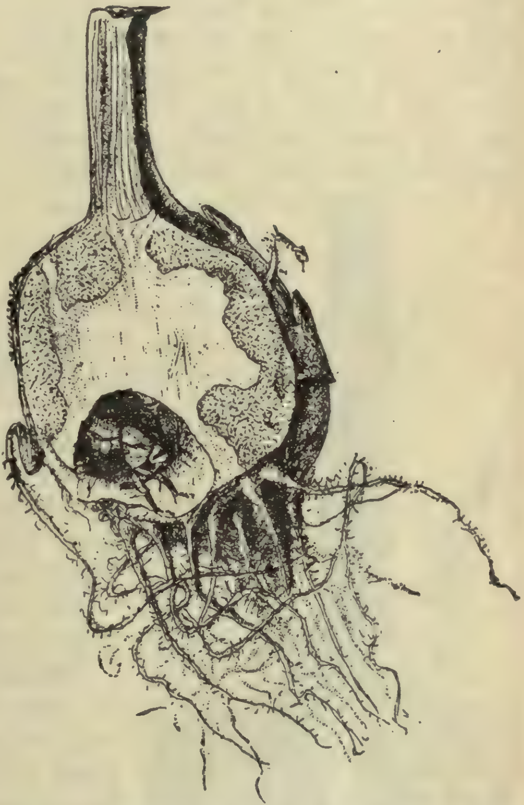

FIG. 13.—Characteristic work of clay-colored billbug in roots of river rush. The presence of these root nuts in corn land should be a warning of the probable presence of the billbug.

MAIZE BILLBUG.[6]

The maize billbug (fig. 14) is four-tenths to six-tenths of an inch long. It is broad and proportionately thicker through the body than any of the other billbugs. It is dark reddish brown or black when not covered or colored with mud, and the wing covers have several raised, rounded, smooth lines running about two-thirds of the way back, these often showing through the mud. Its double injury to corn, as adult and as grub, was observed as early as 1855, and fortunately there are only one or two other species injurious in both adult and larva stages.

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[1] *Chaetochloa* sp.

[2] *Scirpus atrovirens* Muhl.

[3] *S. fluviatilis* Torr.

[4] *Cyperus strigosus* L.

[5] *Phragmites phragmites* L.

[6] *Sphenophorus maidis* Chittenden.

The adult injures young corn plants by piercing the stem and eating out a quantity of tissue. This causes the plant to sucker (fig. 3), thus providing young, succulent corn for the billbug for some time after uninjured corn has become too hard for it. These crippled plants are nonproductive.

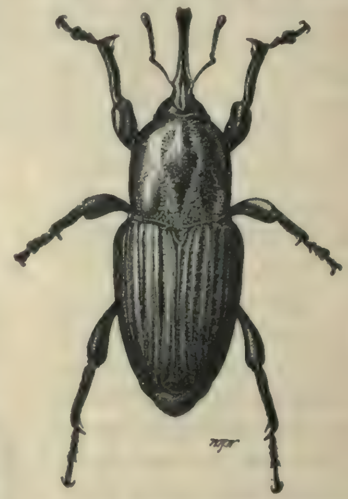

Fig. 14.—The adult maize billbug. Four times natural size. (Kelly.)

The adult billbug also injures the corn by making an excavation for the egg (fig. 15, *b*) in the stalk at or below the surface of the soil. These eggs are creamy white and somewhat kidney-shaped. They hatch in from 7 to 12 days. The grub (fig. 8) feeds within the cornstalk and in the main root, and after 40 or 50 days makes its pupal cell in the upper part of the main root and pupates (fig. 15, *a*). The grub injury to corn dwarfs the plant (fig. 16) and sometimes kills it. The pupal period lasts 10 or 12 days.

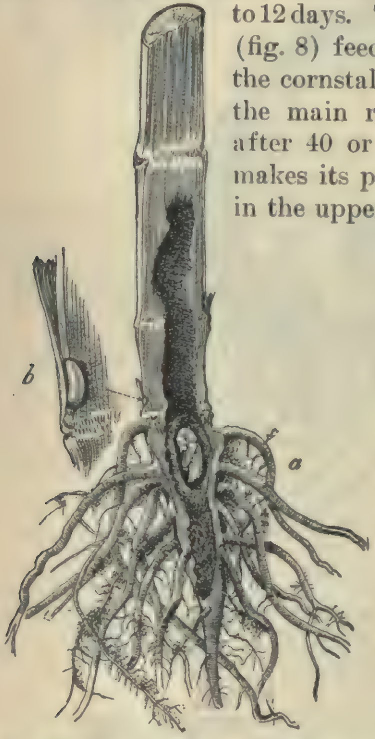

Fig. 15.—Work of maize billbug in corn stubble, showing (*a*) the grub excavation and the pupa in the pupal cell near the top of the main root, and (*b*) egg at or below surface of ground, and egg enlarged. (Kelly.)

The food plants of the maize billbug are corn and grama grass.[1]

The maize billbug, in Kansas, lays its eggs in June, the grubs work from early June to September, and pupæ occur during late August and early September, apparently always in the larval excavation. The early developing adults leave the pupal cells and disappear for hibernation elsewhere; those maturing later hibernate in the grub excavations and may be destroyed by carefully pulling up and burning the corn-stubble and roots.

In Kansas, South Carolina, and Alabama the species is very destructive, injuring corn in both the adult and grub stages. It occurs also in Michigan and Texas.

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[1] *Tripsacum dactyloides* L.

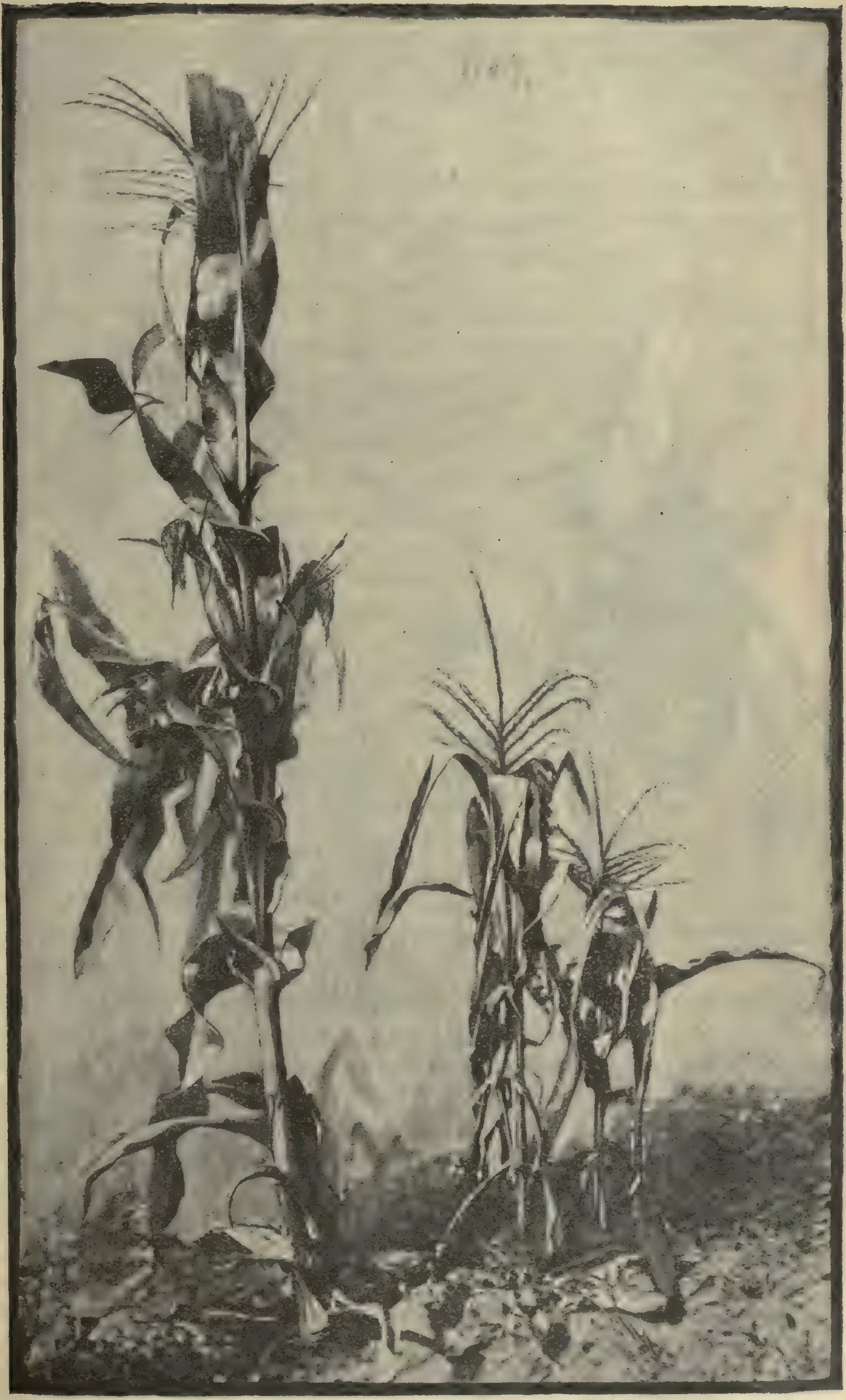

FIG. 16.—Corn plants showing effects of feeding of maize billbug in the field. Plant at left not injured; the two at right attacked by grubs. (Kelly.)

"CURLEW BUG."[1]

The "curlew bug," or southern corn billbug (fig. 17), is a lowland species averaging about three-eighths of an inch in length. The beetle usually is mud colored, but as the natural coating, which is of a brown color with gold in favorable lights, wears off, the more prominent bumps become polished and black. A large dent in each wing-cover near the base and a prominent callous hump near the posterior end of each wing-cover will help in identifying this billbug.

Complete destruction of entire fields of corn by the "curlew bug" is frequent in the South Atlantic States, where the greater portion of the damage is wrought by the grubs feeding in the base of the cornstalk and in the taproot. Similar injury by these grubs is recorded from New Mexico, Oklahoma, and Kansas. After corn, the crops most injured are rice and peanuts, in the order given. Rice crops occasionally are abandoned on account of this pest.

The eggs are laid in corn (fig. 18, *b*), chufa[2] or yellow nut-grass, bristly nut-grass or straw-colored Cyperus,[3] and another nut-grass,[4] and probably all species of plants in which grubs have been found. As many as 447 eggs have been recorded as deposited by one female. The beetles lay their eggs in the stalks of young corn, either under the surface of the soil or within an inch above, and after the corn is older they deposit their eggs in the nut-grasses.

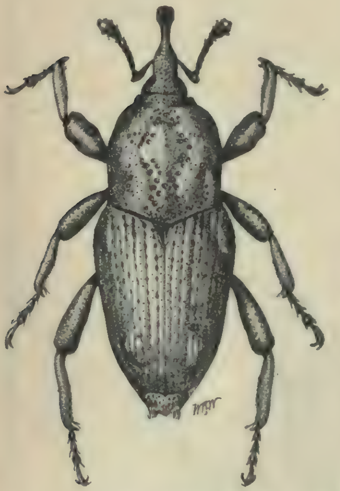

FIG. 17.—The adult curlew bug. Four times natural size. (Webster.)

During the egg-laying season the adults rest under clods of earth, stones, and old cornstalks. Travel by flight is very rarely observed. The early maturing beetles leave their pupal cells in a few days and soon lay their eggs. The egg period is from 4 to 12 days, and the grub period from less than 39 days in midsummer to more than 71 days in autumn, the development being quicker with abundance, and slower with lack of suitable food. The grubs (fig. 19, *a*, *b*) have been found in corn, sedges,[5] grasses,[6] rice, and peanuts.

The work of the grub in corn is well shown in figure 18, *c*.

---

[1] *Sphenophorus callosus* Olivier.

[2] *Cyperus esculentus* L.

[3] *Cyperus strigosus* L.

[4] *Cyperus rotundus* L.

[5] *Cyperus esculentus* L., *C. strigosus* L., *C. rotundus* L., *C. cylindricus* Britt., *C. flavicomus* Michx., *C. ovularis* Michx., *C. exaltatus*, and *Carex frankii* Kunth.

[6] *Tripsacum dactyloides* L. and *Panicum capillare* L.

Pupation requires about 6 to 8 days. The pupa (fig. 20) is white to cream color, and varies in length from seven-sixteenths to five-eighths of an inch. Pupæ may be found within about six weeks after the first eggs are found and until late autumn. Where pupation occurs in corn the position of the pupa (fig. 18, *c*) is lower down than that of the maize billbug (fig. 15, *a*), making the hand pulling of roots useless because the tip, containing the beetle, so often breaks off and remains in the ground.

The adults live from one summer to the following, and their presence is easily ascertained in midsummer in the Wabash and Mississippi Valleys, and probably throughout its territory, by the dead centers, either leaves or flower stalks, in nut-grass plants, even when this troublesome billbug is not, at the time, destructive to corn.

Its range is from Maine to Arizona, and from Wisconsin to Florida, and probably coincides with that of its favorite nut-grass.

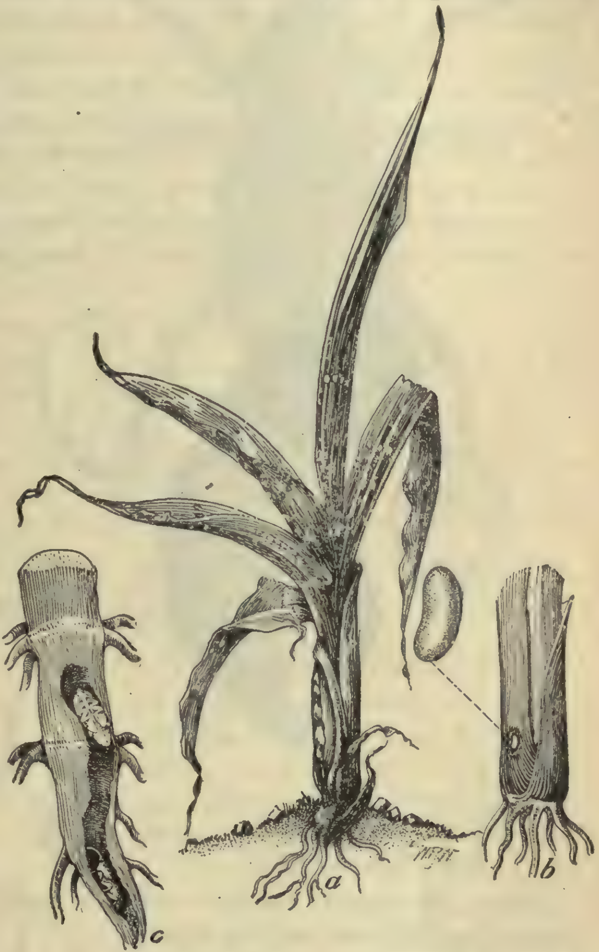

FIG. 18.—The "curlew bug": *a*, Corn plant attacked by adult insect, showing crippled stalk, perforated leaves, and leaf broken at perforations; *b*, egg as placed in young corn plant, and enlarged; *c*, pupa in grub excavation, and adult in excavation near tip of main root, as for hibernation. (Webster.)

TULE BILLBUG.[1]

The tule billbug is the largest of all the injurious species, being about 1 inch in length and is dark brown with light markings on the sides and under surface. A color variety[2] differs only in having additional white markings on its back.

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[1] *Sphenophorus discolor* Mannerheim. [2] *Sphenophorus pictus* LeConte.

This species is not aggressive, but when the farmer incautiously encroaches upon its domain it attacks cultivated crops, such as barley, oats, and wheat.

It occurs in the tule marshes[1] of California from San Diego to north of San Francisco. The grub works in the tule, and the adults begin to work early in the spring, causing losses to growing grain planted adjacent to, or on, recently reclaimed tule swamps.

Although recognized since 1857, its injuries to crops thus far have been limited to the immediate vicinity of the swamps, and greatest on newly reclaimed land, but as it is not known to breed in cultivated crops or to require more than one season for development, clean cultivation for one year eliminates it from such land. When grain is planted within its range, it cuts the heads of the growing stalks at the boot, thus killing the top.

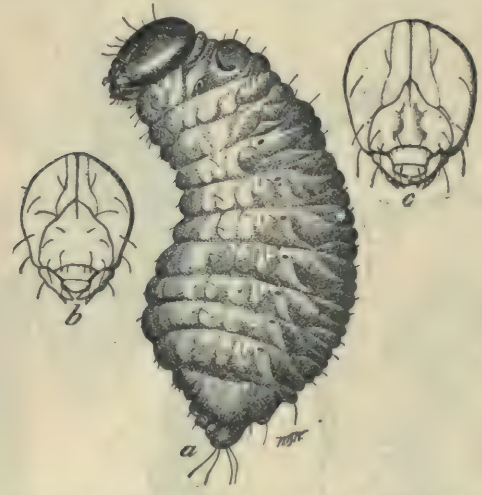

FIG. 19.—*a*, Grub of the "curlew bug"; *b*, head of same; *c*, head of grub of the maize billbug. Much enlarged. (Webster.)

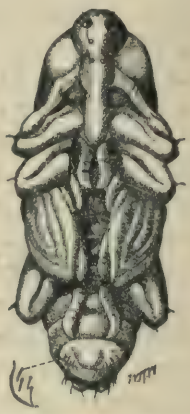

FIG. 20.—Pupa of the "curlew bug." Much enlarged. (Webster.)

CAT-TAIL BILLBUG.[2]

The adult cat-tail billbug (fig. 21) measures from seven-sixteenths to five-eighths of an inch in length and the depressions on its back are coated with pale clay-yellow hairlike velvet.

This billbug has long been considered among the most important of billbug depredators in corn. It was recognized as early as 1807, and by 1873 it was known from Canada to Louisiana and from the Atlantic to the Pacific. It is a lowland species, usually working on cat-tails and flags, but becoming of great economic importance whenever infested waste land is reclaimed for corn growing. The beetle is extensively destructive to growing corn, burrowing into the soil and attacking the stalk from below the surface of the ground and causing the plant to dwarf and fail to ear, rather than to die outright. It thrives equally well in a blue-grass sod. The adults work from April to August and rest hidden in the soil. Egg laying begins by the latter part of June and the eggs usually are placed about cat-tail and calamus flags. The grubs are not found in corn, and they are believed to winter over to some extent in the pupa stage, although generally changing to adults about the last of October.

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[1] The dominant tule is a club rush, *Scirpus occidentalis* Chase.

[2] *Sphenophorus pertinax* Olivier.

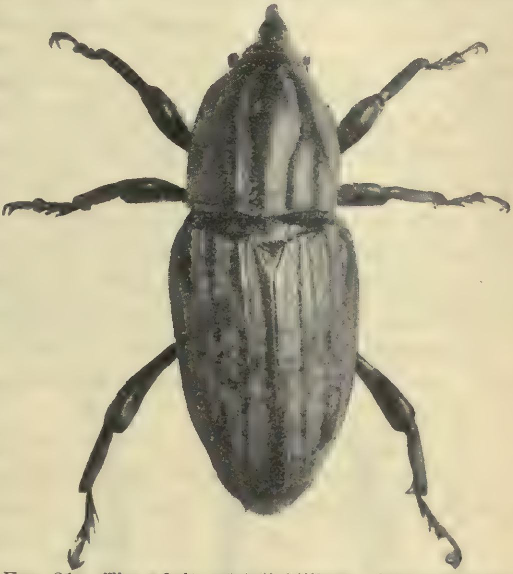
Fig. 21.—The adult cat-tail billbug. Much enlarged.

DESTRUCTIVE BILLBUG.[1]

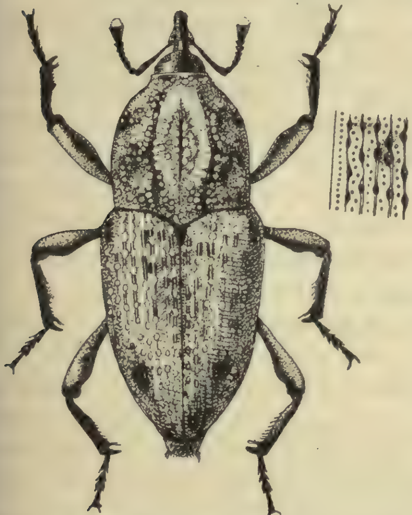
Fig. 22.—Adult of the destructive billbug. Much enlarged. (Chittenden, unpublished.)

The destructive billbug (fig. 22) is from one-fourth to three-eighths of an inch in length, is black, thickly covered with a dull clay-colored or brownish coating, and is rather rough in appearance.

This billbug was well named and is one of the more common species occurring in cornfields throughout its range, which extends from New Jersey to Kansas and Texas. It is especially destructive in Missouri. Observations indicate that the pest is or may become destructive in the larva stage to timothy and wheat. A single female is able to lay at least 30 eggs. Adults are known to live nearly a year. The destructive billbug frequently is found in the same fields as the "curlew bug" and associated with it at the same feeding plants and the same shelters, and usually is second in abundance, at least in Indiana and Missouri.

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[1] *Sphenophorus destructor* Chittenden.

Y-MARKED BILLBUG.[1]

The Y-marked billbug is from one-fourth to two-fifths of an inch in length and is black, densely punctate on the back between the head and wing covers and on the ridges of the wing covers. It is destructive to timothy and corn. The adult injures wheat (fig. 23) and corn in the usual billbug fashion. It is active from April to August or later, laying eggs until August 30, in Missouri. The grub develops in wheat and timothy but its habits are not well known. An illustration of the pupa is given in figure 9, page 9.

The adults are frequently found in drift from high water. Usually they are found in cornfields infested with bristly nut-grass. The species ranges from Maine to Florida and from Wisconsin to Texas and is found only on low land.

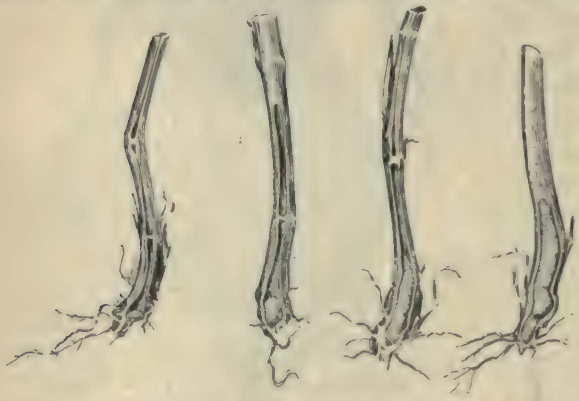
FIG. 23.—Work of the Y-marked billbug grub in the base of wheat stems, with frass left in the excavations.

PHŒNIX BILLBUG.[2]

The Phœnix billbug measures about three-tenths of an inch in length and is variable in color, ranging from light tan, when first mature, to a deep brown or black with a velvety coating of gray to pale reddish. This insect has been known since 1904. It occurs in California and is very destructive in the Salt River Valley of Arizona, in the vicinity of Phœnix, hence its name.

This billbug begins its work early in the spring, often committing serious injury which is not noticed until it is too late to restore the crop, although prompt irrigation may save part by stimulating growth. The beetles congregate, as many as 12 to a single plant, on tender stools of wheat or barley planted on or near to infested old Bermuda-grass sod. They puncture the stems and eat out the soft interior tissue. This work continues from early spring, and even during the warm spells in winter, until the middle of June. Part of the damage by the beetles is done when they excavate places in the plant—usually in the stem, but when the plants are quite young often also in the tender tip—in which to lay their eggs. When the egg excavation or egg puncture is in the tip of the young plant the plant dies. Many stems die early from the punctures, many which remain for harvest produce small heads, and a substantial portion of the stalks fall just before harvest time on account of the damage done to the stems (fig. 7). The economic importance of the pest is measured by crop losses in wheat or barley up to about 100 per cent. Almost without exception only one egg is laid in a stem. The eggs laid in March and April hatch in from 8 to 13 days; those laid in May in from 6 to 8 days. Pupation occurs in compact earthern cells in the soil and rarely in larval excavations in sugar cane from early June to autumn. Development from the hatching of the egg to the appearance of the adult requires about two months.

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[1] *Sphenophorus venatus* Say.

[2] *Sphenophorus phoeniciensis* Chittenden.

LITTLE BILLBUG.[1]

The little billbug is from one-fifth to one-fourth of an inch long. It is dull black, covered with a rich brown pile, which appears when soiled as a pale clay-colored coat. On the forward part of its back are numerous wide, shallow pits.

This little fellow is as sly as the corn billbug in tapping the farmer's till, and uses the same underground system of theft. It occurs from New York to Texas and from Illinois to Florida. The known food plants are timothy, quack grass, and wild rye.[2] It has been found destructive to timothy in Indiana, Ohio, Kentucky, and especially Michigan, where serious damage to sod is common. In the vicinity of Pittsburgh, Pa., this is the most abundant billbug. The amount of damage wrought by it can not be easily determined, for it is very inconspicuous as a beetle and works beneath the surface of the sod. The grub of the little billbug hollows out the corm of timothy plants.

The egg period is known to be less than 8 days, the grub period between 27 and 33 days, and the pupal period 7 days or more. The entire development is frequently accomplished in less than 60 days, though occasionally requiring about 70 days.

NATURAL ENEMIES OF BILLBUGS.

Although the grower can not wait for nature unassisted to control the insect pests which are destroying his crops, nevertheless the good work of the natural checks is by no means to be ignored. These checks are insect, worm, and fungus parasites, toads, birds, and doubtless other insect-eating animals.

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[1] *Sphenophorus minimus* Hart.

[2] *Elymus virginicus* L.

INSECT PARASITES.

Wasplike insect parasites in the grub stage feeding on the outside of billbug grubs have been found at many places and doubtless render considerable aid at times.

A very showy parasite[1] with black wings and red body has been reared from "curlew-bug" grubs from Athens, La Fayette, and Muncie, Ind.

TOADS.

The American toad is a very efficient consumer of insects, adapting itself effectually to farm, garden, or urban hunting grounds. In Arizona 4 out of 10 toads killed from April 4 to July 22, 1913, and dissected to ascertain whether or not they fed on Phoenix billbugs, contained 13 of these destructive insects.

BIRDS.

Many kinds of birds have been found feeding on billbugs. Not only should these be given consideration for the good work they do incidentally when flocks of them gather where the pests are especially numerous, but they should be fostered and protected to increase the value of their services. The elimination of vagrant cats and the placing of proper restrictions upon those valued as house pets will result in the saving of the lives of many birds, as will also the provision of food and shelter for them in winter.

Crow blackbirds, redheaded woodpeckers, and wood pewees are known to feed on the corn billbug and other billbugs, the bobwhite on the corn and blue-grass billbugs, the kingbird on the corn billbug, the English sparrow and various other birds on the blue-grass billbug, the cardinal and phoebe on other billbugs, and the nighthawk on the "curlew bug." The song sparrow and western vesper sparrow, redwing and thick-billed redwing blackbirds, meadowlarks, crow, catbird, brown thrasher, Wilson phalarope, avocet, black-necked stilt, pectoral sandpiper, killdeer, upland plover, and flickers feed on undetermined billbugs, and several of the shore birds mentioned appear especially fond of them.

MEANS OF CONTROL.

Serious injury to cultivated crops by billbugs may be easily prevented by the following simple beneficial cultural practices: Clean cultivation, fall plowing, planting of crops which are immune to billbug injury, proper rotation of crops, improved drainage of damp lands, and community action in adopting control measures.

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[1] *Zavipio belfragei* Cresson.

Clean cultivation in this case means the elimination of nut-grasses and other sedges, and flags, cat-tails, and other rushes, together with other moisture-loving wild grasses, from ground intended for corn. Where possible, the first season after breaking, plant on such ground some crop which is known to be immune to billbugs, such as cotton, cowpeas, soy beans, flax, or Irish potatoes.

Plow damp lands, intended for corn growing, in the fall of the year and see that proper drainage is provided, so as to prevent winter-flooding, where at all possible.

Adopt a suitable system of crop rotation, in which corn will be grown on the same land not longer than two years in succession. In the South cotton, soy beans, or cowpeas may be substituted, if clean cultivation is practiced in order to eliminate sedges, and will greatly aid in controlling billbugs. In the North the growing of crops such as soy beans, flax, or vegetable crops such as potatoes will serve the same purpose. The first year after breaking do not plant corn on ground which has been used for the growing of chufas. This crop is grown in certain portions of the South as forage for hogs, but serves as a breeding ground for several species of billbugs, and serious injury may be expected if corn is planted on such land the first year following this crop.

Thorough drainage of infested land is always of great benefit. Tile drainage is preferable, but where this is impracticable open ditching is beneficial. The addition of lime to damp, sour land usually is necessary, and tends to render such land less suitable for the growth of sedges, rushes, and other moisture-loving plants, which are the natural food of billbugs.

CONTROLLING THE CLAY-COLORED BILLBUG, THE BLUE-GRASS BILLBUG, AND THE CORN BILLBUG.

The clay-colored, blue-grass, and corn billbugs are known to complete their development in bulbs or tubers thrown out by the plow and exposed to the sun for more than a month in the summer. It is therefore not advisable to attempt to eliminate them by plowing during the warm months. Fall plowing, however, has proved to be an excellent means of destroying them. As these billbugs normally feed in the tubers or nuts of the river rush and in sedges it is absolutely necessary that all rushes, sedges, and water-loving grasses be eliminated from infested fields if complete control is to be effected.

CONTROLLING THE PHOENIX BILLBUG.

As the Phoenix billbug can not complete its life history in wheat or barley, but requires Bermuda grass or other large grasses in which to finish its growth, the elimination of Bermuda and other grasses and sedges from grain fields results in the subsidence of injury by this beetle.

CONTROLLING THE "CURLEW BUG" AND THE MAIZE BILLBUG.

The maize billbug and the "curlew bug" are easily eliminated from cornfields by practicing a suitable rotation of crops, alternating corn with cotton or other cultivated crops, such as Irish potatoes, upon which they can not live (fig. 24), and practicing clean cultivation. All chufa or other sedges must be destroyed if complete success is to be secured.

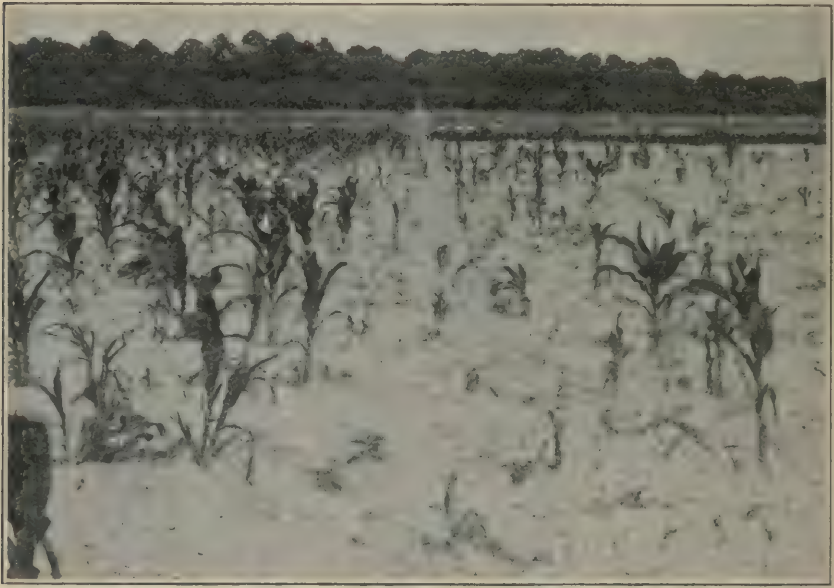

FIG. 24.—Work of the "curlew bug." The portion of corn to the left is following cotton of the preceding year and that to the right is corn following corn infested with the "curlew bug" the preceding year. A nonsusceptible crop, such as cotton or flax, in rotation with corn, saves corn from billbug losses. (Webster.)

CONTROLLING OTHER KINDS OF BILLBUGS.

The control methods for the other kinds of billbugs which have been discussed are practically identical with those which have been mentioned.

OTHER REMEDIAL MEASURES.

Where the preventive measures mentioned previously have not been practiced, it is sometimes possible to prevent the maximum injury from billbugs by using certain palliative methods, such as planting corn at the earliest safe date for the "curlew bug," or wheat or barley early in the fall in the case of the Phoenix billbug.

In corn which has been injured by billbugs, causing the "buds," or growing points, to break over or twist (fig. 2), the "buds" may be immediately clipped with scissors or shears just below the break, as this treatment frequently prevents a partial loss of the crop. The application of suitable fertilizers also enables plants to overcome injuries which have already occurred from billbugs. Before applying such fertilizers, however, the grower will do well to consult the Bureau of Soils of the U. S. Department of Agriculture as to the character of fertilizer to be applied, which should be that best suited to meet the requirements of the particular soil involved.

COOPERATION.

The cultural practices described have proved effective locally, but at least one thing more is necessary to render them fully effective, namely, community action. Community adoption of a two-year maximum period for timothy, early fall plowing, either of cultivated sod or of plain swamp sod, or the planting of flax or of cotton for the first crop, will so reduce injury from billbugs as to render them of little account.

In short, make the best use of the methods that have proved their value, and let every experience gained regarding billbug injuries aid in the further search for better methods, better dates for operations, and means for securing more profitable first crops.

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UNITED STATES DEPARTMENT OF AGRICULTURE

THE GAS TRACTOR IN EASTERN FARMING

TRACTORS using gasoline or kerosene are increasing in numbers on eastern farms. More than 250 New York State farmers furnished detailed reports of their experience with tractors during 1917 and the spring of 1918, and on these the information given in this bulletin is based.

Both the advantages and the disadvantages of the tractor are pointed out.

The farm conditions under which the tractor has proved successful are given, as to acreages and crops grown.

Work ordinarily may not be done more cheaply with the tractor, but can be done more rapidly.

As general conditions are similar in much of New England and the other Northeastern States, these experiences should prove of interest and value to a large number of farmers in this region.

Not every farmer would find a tractor profitable. First cost is high, it requires proper care and handling, and it must do considerable work to make it worth while.

The experiences summarized in these pages should help every farmer to decide whether a tractor will prove profitable to him.

Office of the Secretary
Contribution from the Office of Farm Management
E. H. THOMSON, Acting Chief
Washington, D. C. September, 1918

THE GAS TRACTOR IN EASTERN FARMING

ARNOLD P. YERKES, *Agriculturist.*
L. M. CHURCH, *Assistant in Farm Accounting.*

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THE TRACTOR GAINING FAVOR IN THE EAST.

THE EARLIEST USE of the gas tractor for farming purposes in this country was in the Northwest and Middle West. During the past two or three years, however, these machines have been used in constantly increasing numbers on eastern farms. The information contained herein is derived from detailed reports received from over 250 experienced tractor owners in New York State during 1917 and the spring of 1918. The aim is to present what are considered to be, from the farmer's standpoint, the most important facts and figures reported by these men. General conditions in New York are such as to make the experience of these men of value to farmers who are considering the purchase of tractors for use on farms in any of the Northeastern States. From a comparison of New York reports with numerous reports from other Eastern States, it is believed that the New York farms on which tractors were found are fairly typical of most of the farms in these States on which tractors have already been bought, or for which such purchase would be seriously considered.

The general conditions under which the tractors reported by New York farmers have worked are as follows:

Surface, for the greater part, rolling; soil, a comparatively heavy loam, with heavy clay subsoil, small stones very plentiful and larger ones quite numerous in many cases. The latter range in size from those which will roll out when the plow hits them, to fixed rocks which will cause a breakage of plow or hitch, or a sprung beam unless a wooden break-pin or a spring trip is used.

WHAT FARMS USE TRACTORS.

In considering the results which have been obtained with the tractor on any farm or group of farms, it is, of course, essential that the kind of farming be taken into account.

The farms on which tractors have been used in New York are very diversified. On practically all, at least half a dozen different field crops are grown, while on many farms eight or nine are found. The table below shows the principal crops grown, the percentage of farms on which each was raised, the approximate acreage of each crop for an imaginary farm of 165 crop acres, and the percentage of the crop acreage devoted to each crop. Of course, few, if any, farms actually raised all the crops shown, but the table gives a fair idea of the kind of farming followed.

Crops grown on typical New York farms where tractors are used.

Crop.	Percentage of farms growing.	Acres in each crop, based on percentage shown, and 165 crop acres per farm.	Percentage of crop acres reported in each crop.
Hay	98	64	39
Oats	92	23	14
Wheat	80	25	15
Corn	92	18	11
Barley	48	7	4
Beans	26	7	4
Rye	26	5	3
Potatoes	40	3	2
Orchard	17	5	3
Buckwheat	15	1	1
Miscellaneous	....	7	4

The miscellaneous crops include principally cabbage, tomatoes, peas, carrots, and other vegetables. On a few farms there is a small amount of tillable pasture, which, since it is not strictly a crop and is comparatively unimportant, has not been included.

A small percentage of tractors in New York have been used on farms where more than 40 per cent of the crop acreage was devoted to fruit. These represent only about one-tenth of the tractors, however, and inasmuch as this kind of farming was very dissimilar to that found on a majority of the farms where tractors were used, the records from these fruit farms have not been included in any of the calculations in this bulletin.

The facts relative to the kind of farming followed should be kept in mind in considering the points brought out in the following pages. The fact that more than one-third of the entire crop acreage on practically all of the farms is devoted to hay is particularly important, since most tractors are used little, if any, in connection with the hay crop. Where used their work is usually limited to pulling wagons where hay loaders are used, but even this is not common. The diversity of crops raised in most cases reduces to a comparatively small amount the plowing which must be done annually. This obviously accounts for the fact that a tractor of a given size will prove ample under such conditions for a larger farm than would be the case where only two or three crops are grown, such as the Corn Belt farms, where a greater percentage of the farm acreage is plowed each year.

It should be clearly understood that the figures contained herein represent average results obtained in actual service and not the maximum possibilities of the tractor. These averages are worth more to a farmer in determining the possible value of a tractor for his work than are maximum figures from tests, no matter how carefully conducted. A prospective purchaser may reasonably count upon equaling the average performance of his neighbor. He should strive, of course, to equal the maximum performance of experts, but should not depend upon being able to accomplish such results in order to justify investing in a tractor. For example, an outfit with sharp, new plows, operated by an expert, may plow an acre of ground with, say, 2 gallons of gasoline, but since, under ordinary conditions, with plows that have been sharpened several times and perhaps are not in perfect adjustment, the fuel consumption will ordinarily equal at least the average given herein (about 3½ gallons), it is obvious that the farmer should use the average figure in determining the possible value of the tractor for his work, rather than the exceptional figure.

The question whether a tractor will prove profitable on any particular farm is a problem in farm management which must be worked out for that individual farm. Judging by the reports of owners, however, it will prove profitable on a large percentage of eastern farms of comparatively large size, but should not be expected to do so on farms of much less than 120 acres.

ADVANTAGES AND DISADVANTAGES OF THE TRACTOR.

The important thing for the prospective purchaser of a tractor to know is what the men who have used tractors have found to be their principal advantages and disadvantages in actual practice.

Tractor owners whose reports have been used in preparing this bulletin were asked the questions: "What do you find to be the principal advantages of a tractor for farm work?" and "What are the principal disadvantages?" A summary of these questions showed that the following points were most emphasized:

Works more rapidly.—The greatest advantage of the tractor lies in its ability to perform the work in a shorter time than when horses are employed. This point was mentioned by about 50 per cent of the owners. In New York by far the greater part of the plowing is ordinarily done with walking plows. Even the 2-plow tractor (fig. 1), therefore, results in a considerable increase in the rate of plowing.

Saves man labor.—The saving in man labor was next in importance, as would naturally be expected, as this is the logical result of using a machine which will permit one man to do work faster than with the outfits previously used.

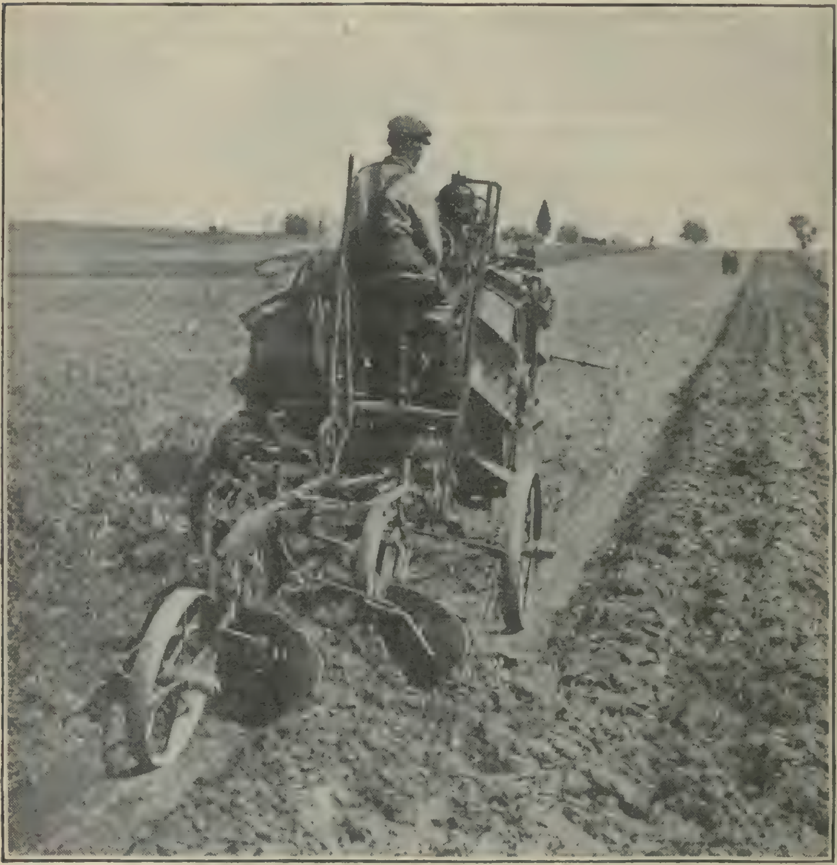

Fig. 1.—The 2-plow tractor effects a considerable increase in rate of plowing over the horse-drawn walking plow, but has proved too small to give the best results on many eastern farms.

Does better work.—The ability to do better work in plowing and preparing the soil is placed third. While economy, power available for belt work, and work in hot weather were given about the same emphasis they were mentioned by only a small percentage of the tractor owners. In regions where considerable plowing must be done in hot weather, the last mentioned advantage is of marked importance, which illustrates how the value of the tractor varies according to local conditions.

Under disadvantages, the inability to use the tractor satisfactorily until the top soil of the entire field is well dried out was mentioned by about 50 per cent of the farmers.

Packs moist soil.—On the comparatively heavy soil in New York packing will frequently be injurious in low spots when most of the field is fit to work, and there is considerable likelihood of the tractor miring in such places.

Inefficient operators.—Next to this feature is the difficulty of obtaining an efficient operator. This is by no means confined to New York or the East, but is generally true wherever tractors are used; it is more fully discussed under "The tractor operator," on page 23.

Breakdowns.—Delays from breakdowns came third in importance, but this is often due to inefficient operation.

Unsatisfactory on rough land.—Unsatisfactory work on hilly and rough land, especially in stony fields, is frequently mentioned. The presence of these features on a farm should therefore be given careful consideration before buying a tractor.

Unsuitable for small fields.—Expense in operation was occasionally mentioned, while unsatisfactory operation in small and irregular fields was referred to in a few cases. Such difficulties, however, can usually be overcome by the rearrangement of fields, removal of fences, and following a proper system of laying out the lands for plowing under these conditions.

Lack of power was mentioned by a few men, but this can scarcely be classed as a disadvantage of the tractor, as it is usually the result of error in choosing a machine too small for the work required of it. This point is important, and is more fully covered under the next heading.

SIZE OF FARM AND TRACTOR.

Though the use of a tractor may be expected to reduce the man labor required for farm operations, thus permitting one man to accomplish more work and so farm more land than with horses, it is obvious that a farm business must be of sufficient size to permit its economical use in order to justify the necessary investment. That is, many small farms must either use the old methods or hire a tractor because the small amount of work to be done each year does not warrant owning it.

Among the more important facts disclosed by a study of the use of the tractor for farm work are those relating to the increase in the acreage which can be farmed by one man when a tractor is used in connection with horses over that farmed with horses alone. Eighty-four per cent of these New York tractor owners say that the tractor has proved a profitable investment to them. Of this number a little over one-third, after purchasing the machine, increased the acreage they were farming. On the other hand, of the men who found the tractor unprofitable, only one-tenth increased their acreage after purchase of the tractor.

This comparatively high percentage of the entire number of tractor owners who have enlarged their farms is significant, for whereas there has been a tendency for the size of general farms to increase in recent years[1] owing to the influence of improved farm equipment, this increase in general is not nearly so pronounced as on farms where tractors are used.

With the tractor, as with any other farm machine, it is important that a suitable size should be selected for a given acreage.[2] By far the larger part of the tractors sold at this time pull either 2, 3, or 4 plows, with the 3-plow size the most numerous, taking the country as a whole. In the State of New York, judging by the reports received from tractor owners, the number of 3-plow machines sold in 1916 was slightly less than one-third of the total number of 2-plow outfits sold in that State. In 1917, however, the 3-plow machines amounted to about two-thirds of the number of the 2-plow rigs. It is evident that the 2-plow tractor has shown itself to be too small for efficient work on many New York farms where it has been purchased, as is indicated by the fact that out of 237 owners 118 say that the 3-plow outfits are more suitable for their farms, while only 110 recommend the 2-plow size; nine men stated that 4-plow tractors would be the best for them, whereas more than two-thirds of the entire number of owners had originally bought 2-plow outfits. This is a very important point for a farmer who is contemplating purchasing a tractor.

While the 2-plow machine is recommended by a majority of owners of farms of 150 or fewer crop acres as being most suitable for farms of that size, even a considerable percentage of these men recommend the 3-plow machines. This, taken with other facts, leads to the conclusion that, in general, the 2-plow tractor does not increase sufficiently the amount of work which one man can do, hence does not possess, in an adequate degree, the greatest advantage of tractors in general, namely, timeliness in performing farm operations through much more rapid work than is possible with horses. Moreover, a 2-plow tractor does not ordinarily develop enough power to make it suitable for operating separators, large ensilage cutters, etc., which are tasks for which power is required on many eastern farms. It happens not infrequently that the owner of a 2-plow tractor has to hire an engine with slightly more power to do his belt work, so it is not to be wondered at that in case he was buying another machine he would select one with more power. The 3-plow tractor is distinctly the favorite among owners of farms containing 151 or more crop acres.

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[1] U. S. Census, 1910, Vol V, Chapter V.

[2] In all cases the size of tractor is referred to by the number of 14-inch plows pulled rather than by the horsepower ratings. This is done because manufacturers do not use a uniform method of rating their outfits, and a comparison of different tractors by their horsepower ratings is practically valueless.

An important point in this connection is the fact that it is exceedingly difficult to keep a gas tractor in such condition that it will develop a high percentage of its rated power at all times, since wear in different parts, imperfect adjustment, etc., may greatly reduce the amount of power it will develop. Hence, a machine which will develop adequate power to meet requirements when new and in perfect order, may prove very unsatisfactory for both field and belt work after having been used a short time.

Another point is that soil conditions in the eastern part of the United States are such as to require considerably more power to do the work of plowing than in most of the Middle West and western sections. This difference is so great that many machines which pull three plows in sections where plowing is comparatively easy, can pull only two plows under eastern conditions.

COST OF TRACTOR OUTFIT.

While the cost of a tractor should not be the only consideration, it is one of the points which a farmer must consider. The prices of the different makes of outfits vary considerably for machines of practically the same capacity, owing to difference in quality, sales systems, efficiency in manufacture, and quantity produced. It is a grave mistake to sacrifice quality for a saving in the first cost, since in no other farm machine does reliability and serviceability count for more than in the tractor. On the other hand, it is poor management for a farmer to invest too large a part of his capital in power.

The price which a farmer can afford to pay for a tractor for use on his farm depends upon (1) the amount and value of the work which the machine will perform annually, (2) the value of the horses which it will displace, (3) the value of the man labor saved, and (4) the amount of increased returns which reasonably may be expected from its use.

The prices paid for the two sizes most commonly bought during 1917 on the New York farms reporting, averaged about $775 for the 2-plow, and $1,050 for the 3-plow machine, while the prices for the plows for use with them averaged about $120 and $145, respectively. In all cases the prices, of course, varied considerably according to the make and quality of the machines. At the beginning of 1918 there was a further general and substantial increase in prices.

LIFE OF THE TRACTOR.

Several factors have considerable influence on the amount of service rendered by a given tractor, by far the most important of which is the care it receives at the hands of the operator. (See "The tractor operator," p. 23.) The quality of the outfit, the kinds of work for which it is used, and the conditions under which it is operated all materially affect its life.

Tractors travel over rough and uneven ground, and are subjected to severe shocks, both from obstructions in the path and from the load being pulled. They are exposed to an almost constant shower of dust and dirt which attacks all gears and bearing surfaces, even inside the engine itself, unless an efficient filter is provided for the air intake to the carburetor. This excessive wear, owing to dust, was a very serious matter with the earlier models of tractors, but many manufacturers have made great progress during the last year or two in protecting their machines in this respect.

It is obviously impossible to determine definitely the probable life of the latest model tractors, since none of them is worn out. Tractor owners were asked for an opinion as to the number of years their own particular machines would give satisfactory service, and also to give an estimate of the average life of farm tractors. The replies to these questions showed a tendency on the part of men who reported the tractor as having been profitable to estimate that their own machines would last somewhat longer than the average machine. On the other hand, men reporting them unprofitable usually gave the probable life of their machines as less than their estimate of the average life of tractors in general. The answers the men gave to both questions, however, averaged very nearly the same, being 9 years for their own machines, and 8½ years for all tractors.

It is interesting to note that the average of the estimates for the years of service they expected to obtain from their tractors on the part of tractor owners who reported that their machines had proved a profitable investment was 9½ years, while men who reported that their machines had proved unprofitable investments gave an average of 5¾ years of service. In a considerable percentage of cases where tractors have proved unprofitable, inefficient operation has largely contributed to their failure.

Of course, the averages here given can not be regarded as being absolutely accurate, but they should be as nearly so as any figures which could be obtained in any other manner at the present time. As a matter of fact there would probably be a tendency on the part of tractor owners to overestimate somewhat. (See "Repairs," p. 12.) It is not believed, however, that a prospective purchaser of a tractor should expect for his outfit a longer life than 8½ seasons (the average estimated life of tractors by tractor owners), and he would be on the safe side if he counted on a somewhat shorter period of service when calculating the probable value of a tractor for his work.

DAYS USED ANNUALLY.

The number of years a tractor will last will depend partly upon the amount of work done each year; that is, the number of days or hours it is used. This varies on different farms as noted above.

Farm tractors in New York are used an average of 54 days annually, including both home and custom work. On farms of 100 crop acres or fewer (average 81), the average days used on the home farm was about 33, while on farms of 151 to 250 crop acres (average 193), the outfits were used on the home farm 47 days, notwithstanding the fact that the machines used on the larger farms averaged larger in size than those on the smaller farms. At the same time tractors on the smaller farms were used considerably more for custom work than were the outfits on the larger farms mentioned.

While at first glance these figures may appear low, when it is remembered that on farms where horses do all the work they are used on an average of only about 100 days annually, it will be seen that where both horses and tractor are used, even though the number of horses is somewhat reduced, the machine need not be expected to have employment for as many days annually as did the horses. The horses kept will still do some of the work, which, of course, will reduce the amount to be done by the tractor. A considerable percentage of the 100 days' work done by horses represents odd jobs for which the tractor can not be used to advantage. Even if the machine were to do all the work formerly done by the horses, it would not normally be employed 100 days per year, inasmuch as it does the work more rapidly than horses.

It should be borne in mind that practically all farm operations must be carried on within limited periods, and that between these seasons there will often be no field work which the tractor can do, either on the home farm or for neighbors. The fact that weather and soil conditions are such as to permit field work with a tractor does not necessarily mean that there is such work to be done. Farm management plays an important part in organizing the farm so as to provide profitable employment for the tractor during as many days as possible. Such organization involves the planning of a crop rotation which will furnish a large amount of work which it can do, the elimination of as many horses as practicable, and the distribution of the work over a long period. However, the rotation should include only such crops as can be grown profitably in that particular region.

The significance of the fact that a large percentage of these New York farmers enlarged their farms after buying tractors is readily apparent when the tractor's place in farm management is thus considered. Obviously these men have learned through experience that much more land per man can be handled when a tractor is used than with horses only, and that to get the most out of their investment they must farm land enough to keep their tractors busy at profitable work throughout as much as possible of the available working season.

TRACTOR REPAIRS.

The extent of repairs required depends upon (1) the proficiency of the operator and the care he gives the outfit, both when in use and when idle, (2) the conditions under which the outfit is used, (3) the load it is required to pull, and (4) the quality of the machine itself. Many tractors are kept in repair by the manufacturer during the first year's service, excepting for such items as are caused by some fault of the operator. It is not until the second year, therefore, that the owner bears the full expense. Of 86 tractor owners in New York who had used their outfits one season or less (average age 9 months), 31 reported that they had spent nothing for repairs. The others had repair bills varying from a few cents to $100, the average being $17, making the average repairs for the entire group about $11. Comparatively few machines go through their second season without repair charges. The average repairs for 102 New York outfits between the ages of 13 and 24 months (average age 18 months) was $34. For 30 machines between the ages of 25 and 36 months (average age 30 months), the average repairs amounted to $101.

These machines were almost exclusively 2 and 3 plow outfits. The repairs were somewhat heavier for the 3-plow than for the 2-plow machines, but the larger machines also averaged more days' use annually, since they were generally on the larger farms.

The statement is frequently made that a tractor should last indefinitely with proper repairs, since all parts are renewable and the substitution of new parts for worn ones will make the outfit as good as new. With practically all machines there comes a time when so many parts have become worn and need replacing that the cost of repairs is so great as to make it unwise to spend such an amount on an old machine, it being more profitable to discard it and buy a new one. Furthermore, it becomes increasingly difficult to obtain repair parts for any machine as years go by. Not infrequently a manufacturer goes out of business or discontinues the production of a particular machine, thus making it impossible, or at least very expensive, to obtain extra parts. It seldom pays to attempt to use bady worn machines where the farming system provides work for the labor and equipment during most of the working season, since such outfits may cause serious delays and a direct or indirect money loss equal to the cost of a new machine. This is especially true of the tractor.

The figures given would indicate an annual repair charge during the first three years of a tractor's life on New York farms of nearly

4 per cent of the first cost, but this would undoubtedly increase during the latter years of its life, as is the case with most other machines. This percentage is slightly higher than in the Corn Belt, due doubtless to the rougher ground and numerous stones which subject the tractor to many sudden jolts and jars which tend to cause breaks. It would not seem safe to expect the cost of repairs for a tractor to average less than that for other farm machines, which is a little over 4 per cent,[1] and it is probable that it will amount to slightly more than this. In figuring the repair costs to be charged against each day of use or acre plowed, the average annual charge has been taken as 4 per cent of the first cost, which is certainly conservative.

THE TRACTOR'S DAY'S WORK.

PLOWING.

The number of acres covered per day by a single plow drawn by a tractor is usually slightly greater than that covered by the same sized horse-drawn plow. The acreage covered by two different machines, each pulling the same number of plow bottoms, often varies considerably because they travel at different speeds, are in different kinds of soil, plowing different lengths of furrows, etc. Theoretically a 14-inch plow when drawn by a tractor should cover approximately 3 acres in an ordinary working day of 10 hours, as the average plowing speed is slightly more than 2 miles per hour. This will hold true in actual practice when the plowing conditions are favorable, provided the outfit does not give trouble. That is, a 2-plow machine should plow 6 acres and a 5-plow outfit 15 acres per day, provided both travel at the average rate of speed and are kept moving. However, where trash is to be turned under which frequently clogs the plows, each plow drawn by a large tractor will cover much less ground in a day than one drawn by a small outfit, since the delays will naturally be in proportion to the number of plows pulled. A delay on account of one plow on a 2-plow outfit stops only one other plow, while on a 5-plow rig, for example, it stops 4 other plows. To illustrate: Supposing a man operating a 2-plow tractor were compelled to stop 10 times during a day for each plow in order to clear it of trash, and spent three minutes each time (which would not be unusual), the loss of time during the day would amount to a half hour for each plow, or but one hour total loss. Each plow would have done nine-tenths as much work as in plowing continuously. On the other hand, a man operating a 5-plow tractor under the same conditions would have to clear each plow the same number of times in proportion to the acreage covered, resulting in a total loss of 2½ hours for each plow during the day. In such case each plow would have done only three-fourths as much work as if plowing continuously.

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[1] U. S. Department of Agriculture Bulletin 338.

In view of these facts it is apparent that when plowing under unfavorable conditions large gang plows do not cover as much ground per day per plow as the smaller ones. However, one man accomplishes considerably more work with the large outfits, even under such conditions.

According to the figures furnished by tractor owners in New York the area covered per day (10 net working hours) in plowing with the tractors most commonly used is 4½ and 6¼ acres for the 2 and 3 plow outfits, respectively.

These acreages are considerably lower than are usually covered by the same sized outfits working under more favorable conditions, such as large, level fields, and lighter soil. The conditions existing in New York, as mentioned on page 4, tend to reduce materially the acreage covered per day with tractor-drawn plows because of the rather frequent delays caused by striking obstructions, more turning in the smaller fields, etc.

OTHER WORK.

The acreage covered per day at field operations other than plowing will vary, of course, with the width of the implement pulled, and this in turn will depend upon the relative draft. It is therefore impossible to give for such operations average figures which would be of value. In harrowing or disking, for example, the width of the implement that can be pulled will depend upon the adjustment of the disks or harrow teeth and the depth to which the ground is being worked (fig. 2). The nature of the soil will also have an influence. The speed of the tractor ordinarily will not be quite as great in soft ground as where the machine has a firm footing, because of the greater slippage of the wheels. On the whole, not so much time is lost on account of clogging or other obstructions when harrowing, disking, etc., as when plowing.

The approximate acreage covered in a day of 10 hours with implements of different widths can be determined easily by allowing about 2 acres per day for each foot of the implement's width where the outfit is working on soft ground. Where it has a good footing it may be safe to allow 2½ acres for each foot of the implement's width. The acreage covered, of course, will vary with different machines, owing to the different speeds, but the figures given are based on a speed of 2 miles per hour, with an allowance for time lost in turning and the overlapping which occurs to a slightly greater extent in most other field operations than in plowing.

By far the largest proportion of the work done by tractors is in plowing and preparing the seed bed and in belt work. While they are used for a number of odd jobs at different times, these represent an insignificant portion of the total work. Hauling, which usually occupies farm horses for several days annually, is not commonly undertaken with the tractor, and in most cases where it has been tried it has been found less satisfactory and more expensive than horses or motor truck. Objections to the use of the tractor for hauling advanced by men who have tried it are the heavy wear and tear on both tractor and wagons on hard roads, expense on the unloaded return trip almost as great as when loaded, and difficulty in handling heavy loads on grades. Restrictions regarding the use of tractors on improved roads doubtless have considerable influence in this matter also. It is not surprising, therefore, that only about 7 per cent of New York tractor owners report doing hauling with their outfits and that on the whole it represents a very small per cent of the work done by the tractor.

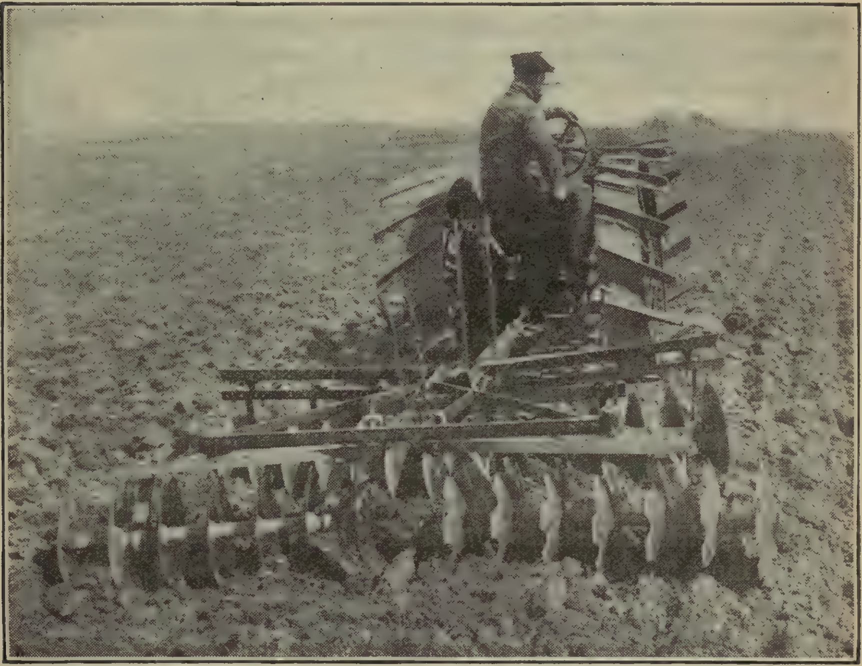

FIG. 2.—In harrowing or disking, the width of the implement that can be pulled depends in large measure upon the adjustment of disks or teeth.

COST OF OPERATING TRACTOR.

Probably the one point in which the prospective purchaser of a tractor will be more interested than in any other will be the cost of performing farm operations with the tractor. This cost is made up of four main factors, (1) operating expenses (including fuel, oil, and grease), (2) repairs, (3) depreciation, and (4) cost of man labor. In addition there will be some less important charges, such as interest on the investment, cost of housing, and time spent in caring for the outfit other than repair work.

When calculating cost of tractor work the mistake should not be made of omitting any of these four items, as each of them will amount to considerable per unit of work. Any other costs will be comparatively insignificant in most cases, although they should be included to obtain a strictly accurate figure.

In order to give the prospective purchaser an idea of the average cost of using a tractor, the following figures for the two sizes most commonly used in New York are presented. From the facts given it is believed that a farmer can approximate the costs for any other size in which he may be interested.

FUEL, OIL, AND GREASE COSTS.

Based on the figures given below for the New York farms reporting, the average cost per acre plowed for gasoline, oil, and grease is about 99½ cents where gasoline is used, and 49 cents where kerosene is used, with an allowance of 2 cents per acre made for gasoline used in warming up.

FUEL.

The average quantity of fuel consumed per acre in plowing for all tractors on New York farms reporting is about 3½ gallons of either gasoline or kerosene. This figure does not vary materially for the different-sized outfits, so long as each pulls its normal load. It is possible, however, to reduce the fuel consumption per acre somewhat by overloading the tractor; that is, adding one more plow bottom than the machine is intended to pull. This reduces the distance the machine must travel to plow an acre, and, consequently, results in a slight saving of fuel. The saving is not in proportion to the actual distance traveled, however, since with the overload there is much more slippage of the wheels and consequent loss of power, and the increased repair bills, and time lost per day through trouble with the tractor, usually more than offset the slight saving in fuel.

There is some slight difference in the fuel consumption between different makes of machines and also usually a slightly lower consumption where gasoline is used instead of kerosene. These differences, however, do not usually amount to a great deal, and for most purposes the figure of 3½ gallons of either gasoline or kerosene per acre of plowing will be as nearly accurate as any that can be used for an average.

Less difficulty is being encountered by owners of kerosene tractors in burning the lower grade of fuel than was the case a few years ago. About 75 per cent of the tractors on the New York farms reporting are operating on kerosene, and where the machines have been especially designed to burn this fuel the results are apparently very satisfactory, particularly in view of the 1918 price of kerosene as compared with gasoline, the former costing less than one-half as much as gasoline. However, the greater ease in operating on gasoline and the somewhat greater certainty of steady operation are sufficient to cause some men to prefer this fuel to kerosene. The fuel consumption, of course, varies considerably, even with the same make of machine and under practically the same conditions when driven by different operators, as a proficient operator will be able to make such adjustments as will reduce the fuel consumption to the minimum, whereas an inefficient operator will frequently run the outfit in such a manner as to increase unduly the amount of fuel used. In this case, as in others, a prospective purchaser is not safe in assuming that he can obtain better results than the average, although of course he should endeavor to do so. In making calculations it is always best to be on the safe side.

The average price paid for gasoline by the New York tractor owners in 1917 was about 25 cents per gallon and for kerosene about 10 cents per gallon. With these prices, therefore, the fuel cost per acre for plowing with the tractor averaged about 35 cents where kerosene was used and 87½ cents where gasoline was used, not making any allowance for warming up the kerosene engine with gasoline. All kerosene tractors start and warm up on gasoline, but the quantity used for this purpose varies greatly with different makes and with different operators. The quantity of gasoline required for this purpose is in most cases less than 1 gallon per day, and the extra cost for gasoline will usually not exceed 10 cents per day, and should seldom be more than 2 cents per acre plowed.

LUBRICATING OIL.

The quantity of lubricating oil used per acre with different outfits showed a much greater variation than the fuel required. Some men reported using over a gallon of lubricating oil per acre, while many reported less than 1 quart per acre. The quantity used will, of course, vary somewhat with the different makes of machines, but the greatest variation will be due to the idea of the operator as to the quantity with which the engine should be supplied.

The average quantity of oil per acre used in plowing, for all tractors reported from New York, was nearly 1 quart. With oil at 40 cents per gallon (the average price paid for it), this would amount to 10 cents per acre. The kind of fuel used does not seem to make any decided difference in the quantity of lubricating oil required per acre, but the 3-plow machines appear to be slightly more economical in this respect that the 2-plow. The difference, however, is practically negligible.

GREASE.

The quantity of grease, or "hard oil," used also varies widely. No attempt to obtain definite figures on this point was made, but 2 cents per acre would be a reasonable figure.

REPAIRS.

Using the figures given under "Tractor Repairs" on page 12, and under "Days used annually" on page 11, i. e., the average annual repair charge as 4 per cent of the first cost, and the days used annually as 54, the average repair charge for the 2 and 3 plow outfits of average price would be 57½ cents and 78 cents per day, respectively. For the average acreage covered with these rigs, the repair charge per acre would therefore be 12¾ and 12½ cents, respectively.

DEPRECIATION.

Assuming the average life of a tractor to be 8½ years (see p. 9), the average annual depreciation on the 2 and 3 plow outfits will be $91.18 and $123.54, respectively. The daily charge, therefore, based on 54 working days per year (see p. 11), will be $1.69 and $2.29, respectively.

The depreciation cost per acre, based on the average acreage covered by the different-sized outfits, as shown on page 13, will be 37½ and 36¾ cents, respectively. From these figures it will be seen that the depreciation charge is one of the largest items which go to make up the total cost of performing work with the tractor, yet it is one which many people ignore entirely when figuring tractor costs. In this case, too, a rather long life has been assumed, which makes the depreciation somewhat lower than would be altogether safe to count upon. (See p. 10.)

MAN LABOR.

Eighteen per cent of the New York tractor owners reporting hire operators, and in cases where the machine is operated by hired help the wages paid vary widely. Some men intrust their machines to ordinary hired hands at comparatively low wages, while others attempt to secure first-class operators and are willing to pay fairly high wages to secure thoroughly competent men.

The cost per acre for man labor will be considerably affected, of course, by the wages paid, although in many cases a high-priced operator may do enough more work per day partly to offset his higher wages, and by reducing operating and repair charges may much more than offset them. The greater reliability of the higher priced operator and the consequent certainty of having the work done when desired also has a value, but the value of this advantage can not be calculated.

To ascertain the cost per acre for man labor in plowing with a tractor, in order to round out these cost figures, the cost for man labor has been placed at $3 per day. This is about the actual cost for operators to many farmers when cost of board, etc., is included, but is less than actual cost on a considerable number of farms. Using this figure the cost per acre for man labor with 2 and 3 plow outfits, based on the average acreage given, would be 67 cents and 48 cents, respectively. The higher the wages paid the greater is the advantage of the larger tractor.

INTEREST.

The interest charge on a tractor is a fixed annual charge, and the interest cost per unit of work obviously will vary with the number of days the tractor is used, decreasing as the number of days used increases. Figuring interest at 6 per cent on the average investment (one-half the first cost) for the different-sized tractors, as shown on page 9, and assuming the average number of days used annually to be 54 (see p. 11), the average interest charge per day for the 2 and 3 plow outfits will be 43 and 58¼ cents, respectively.

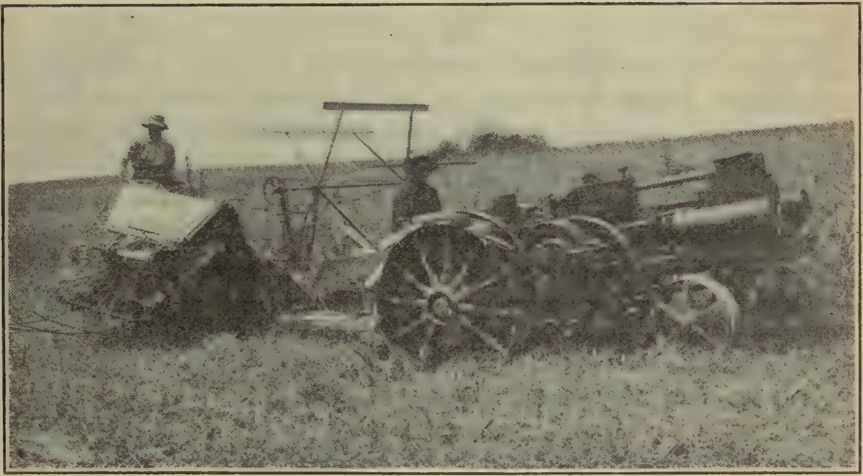

FIG. 3.—Small tractor drawing binder on eastern farm. While slightly more ground is covered per day by this method than by the use of horses, the tractor is of questionable value for such service, since the outfit requires two men as against one where horses are used.

The interest cost per acre, based on the average acreage covered by the different-sized rigs, would therefore be 9½ and 9¼ cents, respectively. The increased acreage plowed per day by the 3-plow rig, as compared with the 2-plow, offsets the increased interest charge due to higher price. It should be borne in mind, however, that the number of days used annually will cause a variation in the interest charge per unit of work.

TOTAL COST PER ACRE.

FOR PLOWING.

The approximate total cost for plowing an acre with a tractor under normal conditions, as calculated from the figures given in the preceding pages, would be as shown on page 20.

Approximate cost of plowing an acre with 2 and 3 plow tractors, based on average cost of $775 and $1,050, respectively, and a life of 8½ years of 54 working days per year.

Size of tractor.	Fuel.		Oil.	Grease.	Repairs.	Depreciation.	Man labor.	Interest.	Total cost.[a]	
	Gasoline.	Kerosene.							Gasoline tractor.	Kerosene tractor.
Two-plow	$0.87½	$0.37	$0.10	$0.02	$0.12¾	$0.37½	$0.67	$0.09½	$2.26¼	$1.75¾
Three-plow	.87½	.37	.10	.02	.12½	.36¾	.48	.09¼	2.06	1.55½

[a] The cost of housing the outfit and other minor overhead charges, such as taxes, insurance, etc., are not included.

FOR OTHER OPERATIONS.

From the figures given above it will be a comparatively easy matter to arrive at relative costs for other operations with the tractor. For all field operations the daily charges for interest, depreciation, and man labor will, of course, be about the same, but must be divided by the acreage covered by the implement used. This acreage will vary with different implements. The fuel and oil charge will be the same for a 10-hour day in other field operations as in plowing, provided the tractor is loaded to the same extent. This, however, is frequently not the case. If a comparatively light load is drawn, the fuel and oil consumption will be somewhat reduced, but not in proportion to the load. For stationary work, if the engine is working to full capacity, the fuel and oil charges will be approximately the same as for a day's work in plowing, but no grease will be used on most machines. This, however, would be only a small item.

ECONOMY OF TRACTOR.

From the figures given under the cost of operation it will be noted that the cost of doing plowing or other field operations with a tractor is fully as great as with horses, omitting the item of man labor. This will average lower with the tractor than where horses are used, assuming wages to be the same in each case.

The advantage of the tractor, therefore, like that of most other improved farm machines, lies not so much in the reduction of the cost of performing a unit of work as in the fact that it permits one man to do considerably more work within a given period of time. This has been true of practically all improved farm machines, even of the grain binder, which is generally considered as one of the greatest agricultural inventions of the century, which did not, contrary, perhaps, to general opinion, decrease the cost of harvesting wheat to any considerable extent, but did increase about eightfold the acreage which one man could handle. (See Department of Agriculture Bulletin 627.)

Men who hope to reduce greatly the cost of farming operations by the purchase of a tractor should bear these facts in mind, and also the fact that few tractor owners mention as an advantage reduction in the cost of performing farm work.

JUDGING by the experience of tractor users, it is not safe to expect any material reduction in the cost of farm operations per acre through the use of the tractor, but it is safe to expect to be able to increase the crop acreage to a very considerable extent, and, at the same time, the amount of crops which one man can raise.

Furthermore, it should be remembered that the cost of doing the work with a tractor as above outlined in most cases can not be directly compared with the cost of doing it with horses, since on farms where tractors are used a number of horses generally are retained, and any comparison, therefore, must be made between the cost of operating the farm with horses alone and the cost of operating with the tractor and a certain number of horses. Not infrequently horses stand idle while the tractor is being used for field work because not sufficient help is available to use them at the same time, and in such cases part of the cost of their maintenance must be considered when figuring the cost of farm operations, since they are as much a part of the farm power plant as is the tractor.

Neither should it be forgotten that not only should the relative expense of operation with the two methods be considered, but also the relative results. The increased crop acreage and consequent increase in incomes which the purchase of the tractor will often make possible may much more than offset a slight increase in the operating expenses of the farm.

The saving in hired help effected through use of the tractor is very frequently quite an important item in reducing the cost of farming operations. That this is quite a factor in a great many cases is indicated by the fact that, of 217 owners, 185, or 85 per cent, stated that the tractor had effected a saving in the amount of hired help necessary to operate the farms. Not all of these men furnished an estimate of the amount saved, but 57 did give such an estimate. The average saved in wages through the use of the tractor on these 57 farms amounted to $213 annually. This would be equivalent to one man for 71 days at $3 per day and would be quite an item on most eastern farms.

In figuring the saving which may be expected from the purchase of a tractor the advantages of having power available for various kinds of belt work should not be overlooked. On most eastern farms there are a number of jobs, such as thrashing, silo filling, shredding, etc., for which belt power is required and which it is highly desirable to have carried on promptly. Where a custom rig is depended upon for such power inconvenience, if not actual loss, is not at all uncommon, owing to delay in obtaining a rig when needed. The gas tractor makes an admirable power plant for such work, provided care is exercised to obtain one with sufficient power to meet requirements. On many farms the purchase of a tractor obviates the necessity of maintaining a stationary engine, thus partially offsetting the investment charge.

QUALITY OF TRACTOR WORK.

Not a few farmers when considering the purchase of a tractor hesitate because of the fear that they may not be able to do the work as satisfactorily as with horses. This applies principally to plowing. That there is little reason for this attitude is indicated by the fact that more than 50 per cent of tractor owners report that the quality of work done by the tractor is better than that done by horses, while only 6 per cent say it is poorer.

The quality of work done in plowing does not depend so much upon the tractor as upon the plow and its adjustment. Under average conditions the work done by most engine gang plows when properly adjusted is fully equal, and often superior, to the work done by either a walking or gang plow drawn by horses and operated by a skillful plowman. If a job of plowing where a tractor is used is not satisfactory it is not usually the fault of the tractor, but of the plow, or, more probably, it is due to misadjustment of the plow. Of course, in fields with obstructions, sharp angles, etc., the tractor may be responsible for poor work because of its clumsiness, but under most conditions the plow and the operator determine the quality of the work done. The tractor's part is to furnish the power to pull the plow.

This point should be kept in mind by farmers who select their tractors by visiting demonstrations of different makes of outfits. The quality of the work done by different machines should be of value in selecting a good gang plow, but it is practically worthless in determining the value of the different tractors. It is quite possible that a tractor of very inferior quality may be pulling a good gang plow, well adjusted, and doing much better work than an outfit of first-class quality which is pulling a poor plow or one that is out of adjustment.

The average depth of plowing done with tractors by the New York farmers who furnished data for this bulletin is a little over 7½ inches. The average depth they had previously plowed with horses was slightly less than 6½ inches. While this deeper plowing is ordinarily considered as indicating a better quality of work, it does not appear to have had any marked effect on the crop yields.

As to the quality of disking, or other work on plowed land, it will, of course, as with plowing, depend largely upon the implement drawn and the skill of the operator. The question of packing the soil is usually more important in connection with work on plowed land than in plowing, but that this is not a serious drawback with modern tractors in New York is indicated by the fact that 95 per cent of New York tractor owners reporting say that their tractors are satisfactory for use on plowed land.

THE TRACTOR OPERATOR.

Difficulty in operation is mentioned by tractor owners as the principal disadvantage of the tractor. Though any man of ordinary ability can operate and care for a gas tractor very satisfactorily after a little study and experience, it is decidedly unwise for him to undertake to gain the necessary experience by experimenting with his own machine. Experience in runing stationary engines or automobiles, while of some value, is not enough. The important thing is the ability to detect trouble the minute it begins to develop and to be able to remedy it promptly instead of allowing it to run along until an expensive delay results.

Many owners report that it is extremely difficult to get hired help capable of operating a tractor satisfactorily. Where a tractor is to be so operated it is very important for the owner to understand the proper care of the outfit in order to see that it is not abused.

Usually the necessary training can be obtained rather easily without great expense. It pays to spend a few days in gaining experience under a competent instructor, and it is unwise to attempt to run a tractor without such preparation. Very often the time and expense involved in obtaining such training will be offset during the first year's operation.

Tractors are being improved and simplified so that difficulties in operation are growing less each year. One generation of well-trained and competent operators will disseminate information so that future generations probably will acquire knowledge on the subject as unconsciously, yet as thoroughly, as the average farmer's son to-day acquires his knowledge of horses.

The mistake should not be made of assuming that any boy can operate a tractor in an efficient manner; only a proficient operator can handle a tractor properly.

Some tractor manufacturers offer to give purchasers of their machines thorough instruction at a reasonable cost, often allowing this charge as part payment on a tractor purchased of them. Purchasers of farm tractors should avail themselves of the opportunities thus offered to obtain a training in the use of the particular machine they will be called upon to operate, which will go far toward insuring their success in its use.

RELIABILITY OF THE TRACTOR.

The reliability of a tractor depends to a very great extent upon the ability of the operator. Of more than 217 tractor owners in New York 48 per cent reported that their outfits were not disabled a single day when needed during the past season. Of the remaining 52 per cent the average number of days their tractors were out of commission when needed was 6¼. This average, however, did not include four men who stated that their machines were out of commission a large part of the time.

The reports of tractor owners indicate that with a careful and proficient operator, a gas tractor is a very dependable source of power. Occasional slight delays probably will be encountered, but serious ones will be exceptional, whereas with a careless or incompetent operator expensive delays are apt to be frequent.

Of the tractors owned by New York farmers reporting, about 82 per cent are operated by the owner or some member of his family, the best results usually being obtained by this class of operators. Twenty-eight per cent of New York owners reported no time lost in the field on account of trouble with the outfit. This probably means that the time lost was not worth mentioning. Most men do not consider it trouble so long as they know at once the cause of stoppage or other irregularity in the engine's operation, and are able to remedy it promptly. The average time lost per day by the 72 per cent reporting trouble is a little less than one hour.

DISPLACEMENT OF HORSES.

Many men expect the purchase of a tractor to enable them to do away very largely with the use of horses for farm work. The tractor has not displaced horses to the extent commonly expected. Its greatest advantage, as before mentioned, has been in the fact that it does the heavy work quickly and thus completes it within the proper season, since it places at the farmer's command a large amount of untiring power when needed.

The tractor does displace horses to some extent, but only in about two-thirds of the cases where it is used on the same number of acres as were previously farmed. In these instances, the horses displaced average about two and one-half.

Considering all farms where tractors have been purchased, regardless of whether or not the acreage was increased after the purchase of the tractor, the displacement of horses is rather negligible, since on 252 farms where tractors were purchased the total work stock (including both mares and horses) owned when the tractor was purchased amounted to 1,321, while the total for these farms after the purchase of the tractor was 1,018, or a reduction of only 303 head, an average displacement of 1.2 horses per tractor, or less than half the number above mentioned, where the acreage remained the same.

New York farms, on account of the great diversification of crops raised, do not offer the most favorable conditions for the displacement of horses by the tractor, since there is much work on these farms for which the machines can not be used profitably. For considerable cultivating and light hauling the tractor is not as economical or as satisfactory as horses. While on some of the larger farms a motor-driven cultivator in addition to the tractor may help considerably in reducing the number of necessary horses, on a great many of these farms the acreage of cultivated crops is scarcely sufficient to warrant investing in one of these outfits.

The decrease in the work stock laid off after the purchase of the tractor on New York farms is almost equally divided between work horses and mares. While it is frequently supposed that the use of a tractor will increase the chances of raising more and healthier colts, hence that a large per cent of the work stock on farms after the purchase of a tractor would be brood mares, the reports received from New York farmers do not bear out this theory, since the brood mares kept before the purchase of the tractor represent 23 per cent of the total work stock, and after the tractor was bought represented but 24 per cent, a gain of only 1 per cent.

TRACTOR CUSTOM WORK.

Many tractor owners in New York purchased their outfits with the idea of using them for custom work, while others got them for use on their own farms only and undertook custom work at the request of neighbors, or because it seemed to offer an opportunity for the tractor to help pay for itself.

The use of a tractor at custom work for field operations seems a rather reliable indication that the home farm is not large enough to utilize a tractor economically. This conclusion is borne out by the fact that the average size of the farms owned by men who use their tractors for custom work is slightly less than for the farms where the tractor is not so used. An efficient farm should be large enough to keep both labor and equipment employed during practically the entire working season. Of course, in the fall, after the work on the home farm is completed, it may be desirable to use the tractor for custom work provided an adequate return can be obtained. This, of course, means that most of the custom work will be stationary operations, like thrashing, shredding fodder, and shelling corn, which can be done after the weather is unfit for field operations.

However, there seems some doubt as to whether it pays as a general rule to use the tractor for custom work even under these conditions. Of the New York tractor owners who have used their machines for custom work, about one-third stated that it had not paid them. It should be noted also that comparatively few farmers consider their entire expenses when calculating the profits from this source. Most of them ignore depreciation charges, and include only fuel, oil, labor, and such repairs as may be required during the time the outfit is used. Under these conditions it not infrequently happens that a tractor owner does custom work at an actual loss, or at any rate at no real profit when all expenses are considered.

On the whole it is preferable that the machine be kept busy on the home farm during as much of the working season as practicable, so that the owner may derive the maximum profit from its use. Certainly a tractor owner is not justified in neglecting his own work to accept employment on a neighbor's farm at the rates usually paid, although this is not an uncommon occurrence. A little ready cash seems to blind some men to their own best interests and to the ultimate profit which should be made through the use of their machines at their own work. For the 42 per cent of New York tractor owners reporting custom work, the average number of days the outfit was used annually for this purpose was 24.

EFFECT ON CROP YIELDS.

The reports of New York tractor owners were studied to ascertain what effect the tractor has had on crop yields. The answers to the questions which were asked on this point indicate that although increases are more common than decreases, they are not sufficiently frequent to warrant a farmer in attaching too much importance to this feature when considering the purchase of a tractor. The principal reason for increases in yields was timeliness in having the work done, although deeper and more thorough preparation of the seed bed was mentioned in several cases. Decreases were usually credited to the packing of the soil when damp, and to delays in getting work done because of trouble with the outfit. By far the largest percentage of owners, however, report no noticeable effect in either direction which can be attributed to the tractor.

Although the depth of plowing done with the tractor averages about 1 inch greater than that done with horses, this seems, from the reports, to have had a rather negligible effect on yields. This is perhaps somewhat contrary to what is generally expected, but is doubtless accounted for by the fact that deep plowing alone does not necessarily increase the yields, other good farming methods and practices being required in connection therewith in order to make it profitable. Furthermore, it may be that in these cases the tractor has not been in use long enough to make apparent the full beneficial effect of deep plowing.

TRACTOR EQUIPMENT.

During the past few years the farm tractor has developed more rapidly than has the field equipment for use with it, with the exception of gang plows. On many farms where tractors are used no special equipment other than plows is bought, other operations for which the tractor is used being performed with the ordinary machines designed for use with horses.

It is obviously impossible to obtain maximum results with a tractor when it is used with implements designed primarily for use with horses, and the objection of many tractor owners that the tractor can not be used with profit for certain types of field work will probably cease to hold good with the development of special machinery for use with the tractor. There is considerable activity at present in the development of implements and attachments designed especially for use with the tractor. Many of these will doubtless increase its value for farm work, making it practicable and economical for many field operations where its use is now both impracticable and uneconomical. It is for the purpose of doing work of the nature last mentioned that more horses are often kept after the purchase of the tractor than would be necessary if the tractor could do the work. With the development of special machinery as above outlined, it seems probable that a higher percentage of work stock will be displaced where the tractor is used.

THE NEXT GREAT FACTOR to enlist for the betterment of Agriculture and rural life in this Nation is the business man of the town and the city. He has not always been alive to his obligations. He has contented himself, in too many instances, with plans to secure profit in agricultural trade, instead of sympathetically and eagerly planning constructive assistance. This duty, pressing in peace time, is of the most urgent and impelling character in this crisis; and I appeal to the bankers and business men to see that they omit no effort to familiarize themselves with the agencies serving to aid the farmers and to promote wise plans to secure the necessary results.

D. F. HOUSTON,
Secretary of Agriculture.

IN THE INTEREST of our national development at all times and in the interest of war efficiency just now our agriculture must be well maintained. It should be remembered that the agricultural unit is a small unit. There are six million farms in this country, each an individual unit. It is to the interest of persons who do not live on farms, even more than to the interest of those who do live on farms, that production shall be kept up. This means that all people, not farmers alone, but those who live in cities as well as the farmers, are interested in experimental and educational activities along agricultural lines as conducted by the Federal Government and the States. These efforts should be liberally supported.

R. A. PEARSON,
Assistant Secretary of Agriculture.

IN A TIME LIKE THIS no man has a moral right, whatever his fortune may be, to employ another man to render any service of mere comfort or convenience. When the finest young men of the United States are in France digging ditches, sawing lumber, laying rails, and playing with death, and when the finest young women of the United States are scrubbing floors in hospitals, it is a sin that almost approaches the unpardonable offense against civilization for any man or woman in the United States to engage in a wasteful or unnecessary service.

CLARENCE OUSLEY,
Assistant Secretary of Agriculture.

TO THE PATRIOTS ON THE FARMS.

You are asked to undertake another offensive—to go " over the top " this fall for a great harvest of wheat in 1919. I need give only a few figures and facts to impress you with the increasing and urgent need of our people, our armies, the allied peoples and their armies for large supplies of American wheat.

Our reserve supply or carry-over from the 1917 crop is practically exhausted and is the smallest on record. The need of building up reserves of wheat is evident. Although this country produced a small crop of this grain in 1917, the total exports of wheat in excess of imports, including flour in terms of wheat, amounted to approximately 100,000,000 bushels for the year ending June 30, 1918. This is in comparison with 178,000,000 bushels exported in 1917, 236,000,000 bushels in 1916, and 331,000,000 bushels in 1915. It was possible for the United States to export wheat in large quantities in 1915 and 1916 only because of the large wheat crops of 1912–13–14–15, which gave this country an accumulation of stocks of this grain. Both the 1916 and 1917 crops were smaller than any crops since 1911 and besides this there was a greater demand for seed wheat and an increased population to be fed.

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Moreover, it must be borne in mind that the carry-over in all the ten importing countries in Europe was practically exhausted this year before the new harvest; that the normal requirements of the exporting countries are increasing instead of diminishing; that some losses in storage and transit may be expected to continue; and that it is highly desirable that a surplus should be accumulated as insurance against partial crop failure next year.

You have been asked to sow to winter wheat this fall not less than 45,000,000 acres—an increase of 7 per cent over last year's sowing—and the department has suggested that an even greater area, 47,500,000 acres, is desirable. The increased planting asked of each State has been carefully determined with regard to its local conditions and its reasonable capabilities. Your county agent can tell you the quota assigned to your State and you can apply the responsibility to your case.

You have occupied and do occupy the first line trenches of the food army. You have to fight difficulties, too. I am not unmindful of these. In the Department of Agriculture we consider them daily, and daily we give our best efforts to help you meet them. You know of the difficulties in your community, but I know of them in many communities of many States, and so seriously do they impress me that I might almost consider them insurmountable had not American farmers last year, and again this year, revealed the true American fighting spirit and ability to meet serious situations. They will not let the war fail because of deficient food production.

Let us sow liberally for a big harvest in 1919. It has been called the Liberty Wheat Harvest. We all hope it will be. But let us undertake the task with the determination that we will sweat our blood for many more if need be before we yield one measure of our freedom to a Prussian domination. Let us fight in the furrows.

D. F. Houston

Secretary of Agriculture.

THE FARMERS OF THIS COUNTRY are as efficient as any other farmers in the world. They do not produce more per acre than the farmers in Europe. It is not necessary that they should do so. It would perhaps be bad economy for them to attempt it. But they do produce by two to three or four times more per man, per unit of labor and capital, than the farmers of any European country. They are more alert and use more labor-saving devices than any other farmers in the world. And their response to the demands of the present emergency has been in every way remarkable. Last spring their planting exceeded by 12,000,000 acres the largest planting of any previous year, and the yields from the crops were record-breaking yields. In the fall of 1917 a wheat acreage of 42,170,000 was planted, which was 1,000,000 larger than for any preceding year, 3,000,000 greater than the next largest, and 7,000,000 greater than the preceding five-year average.

But I ought to say to you that it is not only necessary that these achievements should be repeated, but that they should be exceeded. I know what this advice involves. It involves not only labor, but sacrifice; the painstaking application of every bit of scientific knowledge and every tested practice that is available. It means the utmost economy, even to the point where the pinch comes. It means the kind of concentration and self-sacrifice which is involved in the field of battle itself, where the object always looms greater than the individual. And yet the Government will help, and help in every way that is possible.—*From President Wilson's Message to the Farmers' Conference at Urbana, Ill., January 31, 1918.*

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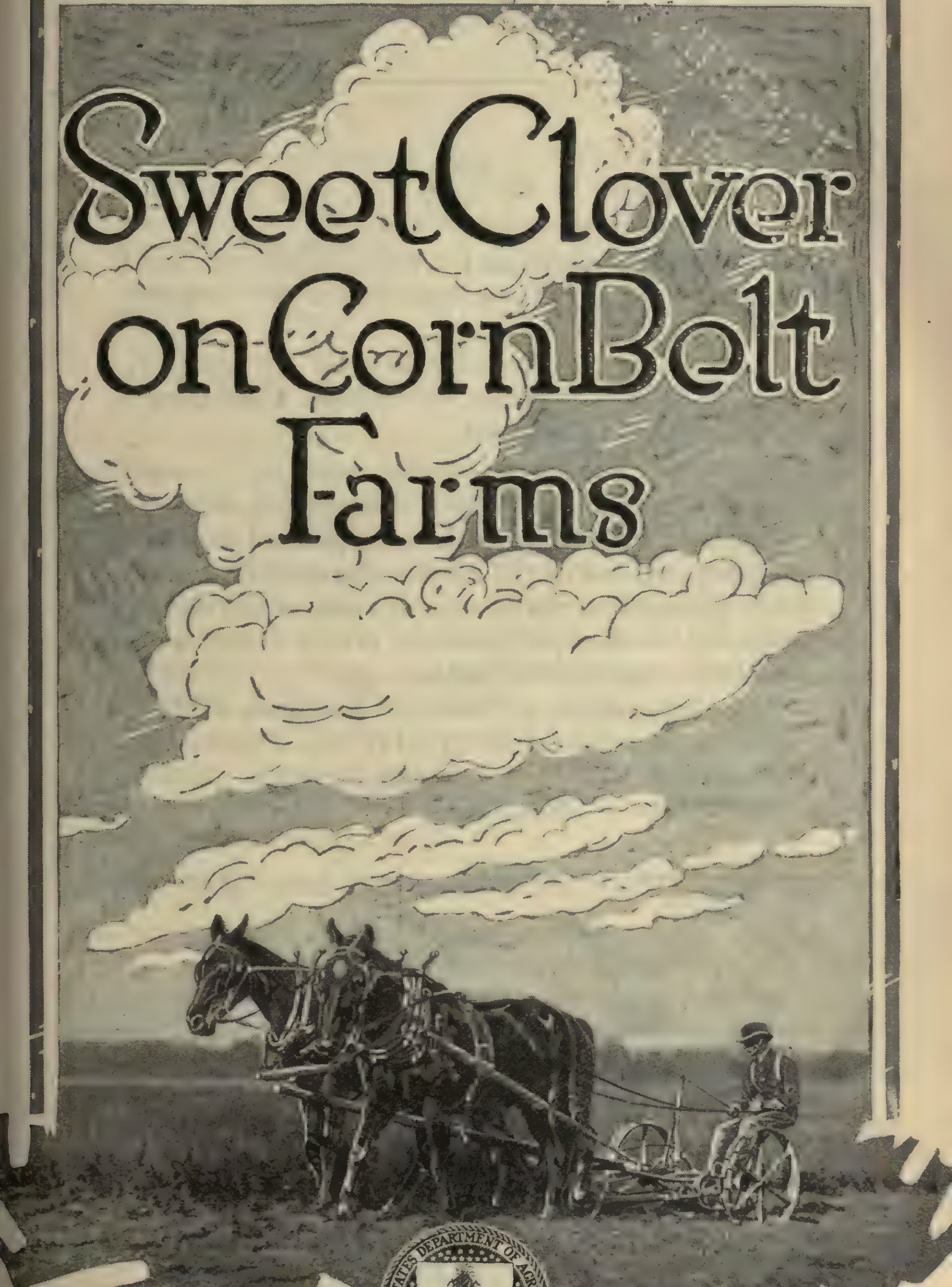
Farmers' Bulletin 1005
United States Department of Agriculture

Sweet Clover on Corn Belt Farms



1862 1889

SWEET CLOVER is now grown successfully on many farms in the corn belt, both in rotation and as a catch crop to be plowed under.

It has proved excellent for hay and pasture, and is unequaled by any other legume for soil improvement.

Sweet clover may be used to good advantage for silage, and on some farms, with proper management, it is a profitable seed crop.

Mixed with bluegrass, it makes a pasture of nearly double the carrying capacity of bluegrass alone.

The object of this bulletin is to present details of management and of the more important farm practices followed on some of the successful corn-belt farms on which sweet clover is grown as one of the principal crops of the rotation.

Cropping systems are outlined for farms of different types, and special attention is called to the three essentials of success in growing the crop—lime, inoculation, and scarified seed.

Office of the Secretary
Contribution from the Office of Farm Management
E. H. THOMSON, Acting Chief
Washington, D. C. January, 1919

SWEET CLOVER ON CORN BELT FARMS.

By J. A. Drake, *Agriculturist*, and J. C. Rundles, *Scientific Assistant*.

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SWEET CLOVER AS A REGULAR CROP.

THE VALUE OF SWEET CLOVER has been demonstrated on numerous farms in the corn belt. Hitherto, however, it has been grown in this region mainly on odd fields, outside of any set rotation or cropping system. As yet, comparatively little attention has been given to fitting sweet clover into the farm system as one of the regular crops. It is the purpose of this bulletin to describe the cropping systems and farm practices followed on a few farms where the problems arising in this connection are being worked out satisfactorily. It is believed that corn-belt farmers who wish to grow sweet clover may save themselves much of the expense and trouble of experimenting by studying the methods of management followed on these farms and the way in which the crop is handled where it is used to best advantage.[1]

THREE THINGS ESSENTIAL TO SUCCESS WITH SWEET CLOVER.

The fact that sweet clover is found growing as a weed along a roadside is no indication that it will thrive in adjacent fields. Frequent trials have shown the folly of depending upon such indications. Success with sweet clover is rare unless three essentials of such success have been provided, namely, lime, inoculation, and scarified seed—that is, seed that has been so treated as to scratch or crack the hard coat and make it easy for moisture to penetrate and hasten germination.

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[1] In addition to those whose names are mentioned in the text, the writers wish especially to give credit to Mr. Roy C. Bishop, county agent, Livingston county, Ill., and to Prof. H. D. Hughes, chief, division of farm crops, Iowa State College. Both men have given valuable assistance in furnishing the names of farmers who are growing sweet clover as a regular crop on their farms, as well as furnishing important information, each in his particular field of work.

NOTE.—For a full discussion of sweet clover and the details of how to grow it, the reader is referred to Farmers' Bulletin 797. Directions for harvesting and thrashing the crop are given in Farmers' Bulletin 836, and the principal points in its utilization and the palatability of the crop as hay, silage, and pasture are given in Farmers' Bulletin 820. For a comprehensive knowledge of the subject, these bulletins, together with such State publications as are available, should be studied carefully.

USE OF LIME.

The first and most urgent requirement of sweet clover is lime. Probably more failures with sweet clover throughout the corn belt can be traced directly to lack of lime than to any other one cause. The absolute necessity of lime in growing sweet clover presents a serious difficulty where farms are located at a considerable distance from any shipping point or limestone quarry.

In some sections a ton of finely ground limestone, or one-half that amount of hydrated lime, well worked into the surface soil, will suffice. In many parts of the corn belt, however, it is unwise to attempt to start the crop without a fairly liberal application, preferably of limestone. The necessary application ranges ordinarily from 2 to 3 tons per acre.

If sweet clover is to be rotated over the entire farm lime should be applied to each field before the crop is sown thereon for the first time. An exception to this rule may be made in limestone sections where alfalfa is known to do well naturally, or where actual experiments have shown that sweet clover can be grown successfully without the application of lime. Even in limestone sections it often happens that the surface soil is deficient in lime.

INOCULATION.

Inoculation is very important and should not be neglected. In some sections certain soils have the required bacteria already present, but unless this fact has been fully determined, failure to inoculate either the seed or the soil of the field adds a big element of uncertainty. (For a full discussion of the importance of inoculation, together with the methods employed, see Farmers' Bulletin 797, pages 27 to 29, and for a discussion of the glue method more especially, Farmers' Bulletin 704, p. 25.)

SCARIFIED SEED.

The sowing of scarified seed often means the difference between a good stand and one that is very poor or even altogether lacking. It is true that much of the seed raised in some sections of the corn belt is sown locally without having the tough seed coat roughened by the process known as scarifying. Good stands are often secured in this way, but generally more seed is required than when scarified seed is used, and the practice entails an unnecessary risk. Scarified seed usually can be secured through local seedsmen at a slight additional expense, or home-grown seed can be sent to seed houses to be scarified at a nominal cost. It is especially important to have sweet clover seed scarified if it has been grown in a dry climate. (For further discussion of scarifying sweet clover seed and a description of a scarifying machine, see Farmers' Bulletin 979, p. 20.)

FITTING SWEET CLOVER INTO THE FARM SYSTEM.

With preparations made for meeting the preliminary and most important requirements for growing sweet clover successfully, the next step is to consider the crop with reference to the farm as a whole—to the cropping system, the type of farming, and the labor schedule—and to determine the proper relation of sweet clover to the other crops of the farm.

The general characteristics of sweet clover make it an easy matter to place it definitely in any of the rotations or cropping systems common to the corn belt. The introduction of this crop makes possible also new arrangements of crops and systems of farming not now in common use. Sweet clover is a biennial, and fits well in either short or long rotations much the same as common, red, mammoth, and alsike clover, timothy, or mixed hay. Unlike alfalfa, it may be rotated over the entire farm in a comparatively short time. In addition to filling a valuable place in various corn-belt rotations as a hay, pasture, silage, or seed crop, it serves as an emergency pasture or as an extremely valuable crop to be plowed under for soil improvement.

AS A CATCH CROP TO BE PLOWED UNDER.

Sweet clover may be sown between two of the main farm crops of the rotation to serve the purpose of a green manure crop without occupying the land during a full crop season. Grown thus, it makes a better crop for plowing under and gives more growth than any other legume common to the region. If conditions are right the sweet clover will grow with great vigor after the small grain crop in which it is sown is taken off. By late fall it has usually made a growth equivalent to approximately a ton of hay per acre. Sweet clover may be plowed under either in the fall or spring. Some growers prefer not to plow under the fall crop of the first year, for fear that it will come up again the next spring and be troublesome in the crop of corn or oats which is to follow.[1]

The danger of sweet clover coming up and being troublesome when plowed under in the fall depends very largely upon the manner in which the plowing is done. If the plowing is thoroughly done there is little danger in this connection. This, however, is a much disputed point among growers in general, and men of considerable experience gave it as their belief that sweet clover should not be plowed under until late in the spring of the second year after seeding. On the other hand, at least one instance was found in which this danger was entirely ignored and without any apparent bad effect.

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[1] Sweet clover, being a biennial, reaches maturity in the fall of the second year after seeding. The terms "first-year crop" and "second-year crop" are used by sweet-clover growers to designate, respectively, the growth produced during the first year and the second year after seeding.

The practice in plowing under sweet clover followed by Mr. J. M. Neilis, of Lee County, Ill., is believed to be well worthy of consideration in this connection. Mr. Neilis has proved to his own satisfaction that the crop can be plowed under in the fall or early spring without trouble following. For a number of years he has made it a practice to plow down sweet clover whenever it suits his convenience, and it has never come up so as to damage other crops which follow. The secret of his success, however, is that he does his plowing well, and insists that everything be turned under completely. The results secured in plowing under sweet clover in this way for a number of years on a farm which is naturally well adapted to the crop and on which it grows vigorously, constitutes strong evidence that sweet clover can be used as a catch crop, and plowed under at the option of the grower, provided the plowing is well done and no tops of the sweet clover are left sticking out of the ground. Figure 1 illustrates the method of plowing sweet clover under followed on the Neilis farm, and shows how well the work is done.

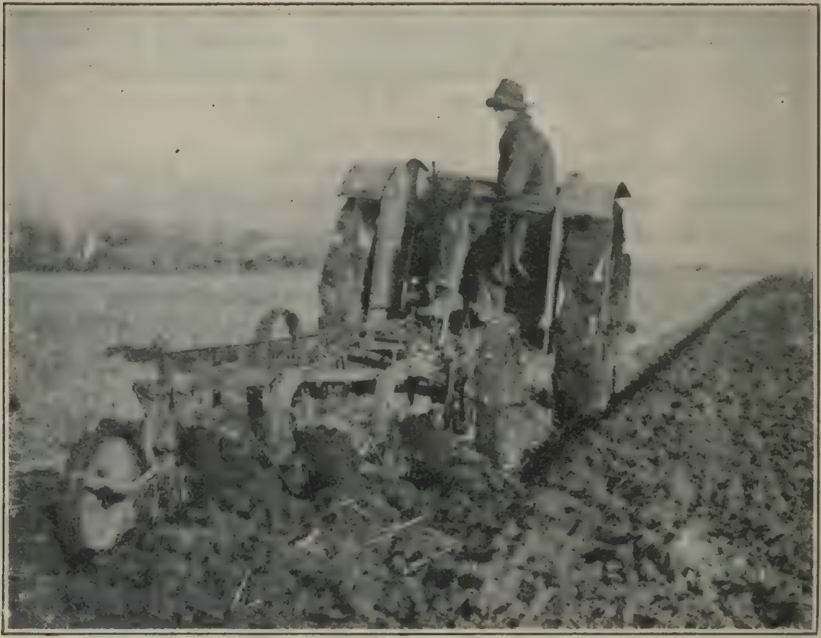

FIG. 1.—Plowing under the first year crop of sweet clover late in the fall after heavy pasturing. A special jointer is used to make sure that all tops are turned under.

In using sweet clover as a catch crop the most general practice is to wait until comparatively late in the spring of the second year and then plow it under in preparation for corn. The plowing is generally postponed until about the middle of May in order to have a good growth to plow under, and by that time the sweet clover usually will have made a growth approximately equal to a ton of hay per acre. Though May 15 is a little late to plow for corn, farmers are following this practice, depending upon the beneficial effect of the sweet clover plowed under to push the growth of the corn and make up for the delay in planting. In some instances early maturing varieties of corn are used with a special view of permitting of late planting. Generally the yield of corn when planted after a good growth of sweet clover is plowed under is considerably greater than corn planted earlier on similar soil which has not had the benefit of a sweet clover crop.

There is one difficulty in this procedure. In postponing the plowing date until approximately the middle of May, dry weather often makes plowing rather difficult at best, and especially difficult where there is a heavy growth of sweet clover roots. Where the plowing is done with teams, this is a serious matter, but some of the sweet clover growers on the larger farms are meeting this difficulty by the use of tractors.

Whenever it is possible to manage the plowing successfully, this practice becomes a very effective means of soil improvement. In fact, even though used only as a catch crop for plowing under, sweet clover may be well considered a valuable crop for the corn belt.

SWEET CLOVER FOR HAY.

Sweet clover growers generally prefer the fall crop of the first year for hay, since the growth then is finer and the hay is of better quality than at any other time. The hay cut from this crop is practically equivalent to first-class alfalfa hay. Usually there is taken up with it some stubble from the small grain crop in which the sweet clover was sown, but this feature is not objectionable when the hay is for farm use. On soil that is limed and inoculated so as to put it in condition for the best growth of the crop, approximately a ton of hay per acre can be cut in September or early in October. A full crop of grain, such as oats, wheat, or rye, and in addition a ton of first-class hay, make altogether a highly satisfactory return on the land for one season.

In the spring of the second year the growth of sweet clover is more rank and somewhat coarser than that of the preceding fall. Some growers do not use the spring growth for hay, but others cut it regularly and are well satisfied with the results. The spring crop should seldom be cut later than May 26 in the latitude of central Illinois, because of danger of killing the plants, but by that time from a ton to a ton and a half of hay can usually be taken off, and in exceptional cases even more. At this season of the year curing is naturally somewhat difficult, but by using the side-delivery rake, the hay can be allowed to cure in the windrow for a considerable time without suffering any great damage through exposure to the weather. Live stock in general eat readily the hay cut from the spring crop. If desirable, a second crop of hay can be cut in the early fall of the second year. Where this is done the crop which otherwise would mature seed is cut while in blossom. The grain binder is generally used in cutting this crop and the hay is tied in bunches and shocked in such a way as to permit thorough curing. This hay is rather coarse for cattle, but is excellent feed for horses. Horses and mules will clean up all the roughage with little if any waste. (For full discussion of sweet clover as hay, methods of curing, etc., see Farmers Bulletin 820, pp. 10 to 20.)

USING SWEET CLOVER FOR PASTURE.

Contrary to the general belief that sweet clover is not palatable to stock, this crop is used on some of the more successful farms of the corn belt as the principal pasture crop. There is no trouble in getting live stock to eat sweet clover pasture readily unless the growth is too big and tough before the animals are turned in on it for the first time. Even then there is little trouble unless there is an abundance of other pasturage which is more succulent. The numerous instances of an extensive use of sweet clover as the main pasture crop of the farm are sufficient evidence that, if rightly managed, this crop may be depended upon for pasture purposes throughout the corn belt.

With conditions favorable for its growth, sweet clover, as usually sown in the spring in oats, gets a vigorous start and grows rapidly after the oats crop is harvested. The fall crop of the first year is most excellent pasture. The growth is not coarse or woody and the quality compares favorably with that of the best alfalfa pasture. Owing to the peculiar root system the fall crop of sweet clover may be pastured heavily by all classes of live stock without danger of killing or injuring the stand.

In the spring of the second year sweet clover as a rule can be pastured two or three weeks earlier than any of the other regular pasture crops now in common use. The crop starts growing very early and live stock should be turned in as soon as a good "bite" is available Here again there is little if any danger of injury to the stand from close pasturing. To keep the quality of the pasture good during the spring and early summer of the second year, enough live stock should be grazed to keep it down. If it grows too high it is necessary to clip in order to keep it back and bring out new shoots. It is better usually to pasture heavily enough to make clipping unnecessary. If it becomes advisable to clip, the cutter bars should be set high enough to avoid killing the sweet clover plants. (See Farmers' Bulletin 820, pp. 12–17.) One of the principal difficulties in pasturing sweet clover comes usually from allowing the second-year crop to get too woody and tough, especially when it is used for hog pasture. Cattle and horses eat the rank growth better than hogs, but often, even for these classes of live stock, the growth must be kept down to get the best results.

When animals refuse to eat sweet clover pasture it is usually because the growth is too rank before they have acquired a taste for it, and if the pasturing is handled properly no trouble is ordinarily experienced in this connection. During the summer of 1917 Mr. W. E. Riegel, of Champaign County, Ill., bought cattle, young horses, and mules from time to time during the entire summer and turned them in on sweet clover pasture. In no instance had the animals been accustomed to eating sweet clover pasture, but no difficulty was experienced in getting them to eat it readily. (For a full discussion of different phases of sweet clover as a pasture crop and some of the results obtained, see Farmers' Bulletin 820, pp. 4 to 10.)

SWEET CLOVER FOR SILAGE.

Sweet clover may be used for silage, but as yet this practice has not become common in the corn belt section. Those who have used it thus, however, are very enthusiastic over the results obtained. Some growers have put the fall crop of the first year in the silo. This crop makes excellent silage, although ordinarily it is preferable as hay. The spring crop of the second year is also used for silage, but the objection is raised that the sweet clover at this time of the year is so watery that it floods the silo and usually much of the juice of the silage is lost. In the early fall of the second year the crop which would otherwise produce seed may be cut with the grain binder while in blossom and put in the silo. In some instances as high as 10 tons of silage per acre have been produced in this way. Doubtless the most economical way of producing ensilage with this crop is to utilize for this purpose the straw left after thrashing the seed crop. In making the silage thus it is essential to wet the straw thoroughly with water while it is being put into the silo. If handled properly this by-product, which otherwise might be wasted, makes excellent feed. (See Farmers' Bulletin 820, pp. 20–22.)

SEED PRODUCTION.

The production of sweet clover seed in the corn belt is one of the greatest difficulties encountered in handling the crop in this section. The seed crop is very difficult to harvest, and the results in general are somewhat uncertain. (See fig. 2.) The yields vary from a total failure to from 10 to 12 bushels per acre. On the farm of Mr. Frank Barton, Livingston County, Ill., 8 acres of sweet clover in 1917 produced 10 bushels of good seed per acre, which was sold at an average price of $11 per bushel, making a gross income of $110 per acre. At the same time some of the other growers in this section, men who have had several years of experience in seed production, suffered an almost total failure, but practically all of them were at a loss to know definitely why. There are many causes of failure which make seed production a rather doubtful enterprise for the average farmer, especially until considerable experience has been attained.[1] (For a full discussion of seed production see Farmers' Bulletin 836.)

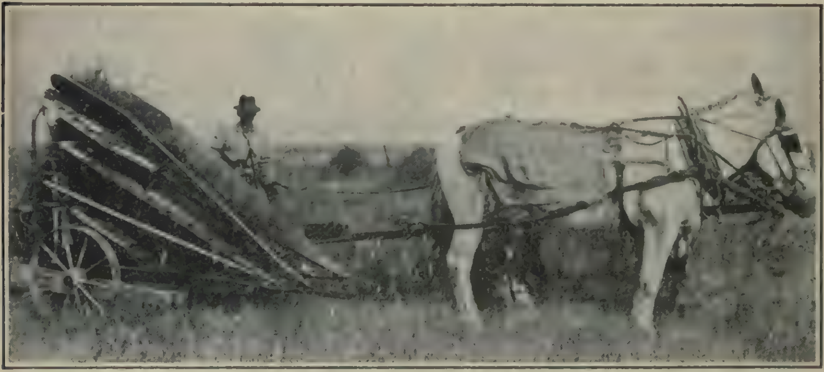

FIG. 2.—If not cut for hay, clipped or pastured, the second-year crop often grows so high that it is necessary to cut the seed crop with the corn binder.

LABOR DISTRIBUTION.

In fitting sweet clover into the cropping system the problem of labor must be considered in its relation to the work necessary on the other farm crops, and the season of the year at which this work must be done. While there is some conflict in labor between sweet clover and other crops, with reasonable acreages the extra work can be managed without great difficulty, and it should not be considered a serious objection to growing sweet clover as a major crop.

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[1] Aside from the difficulty in harvesting sweet clover seed, thrashing offers another serious obstacle under ordinary conditions. Usually the crop is first run through a grain separator and afterward the unhulled seed, chaff, etc., which is secured in this manner is then run through a clover huller, the latter operation being necessary in order to hull the seed successfully. The lack of experience of local thrashers in handling the crop is often a serious matter. This was the case with the 1917 crop on one farm in La Salle County, Ill., where out of a yield of probably 8 bushels per acre, only 2 bushels per acre were secured.

When it is necessary to use both the grain separator and clover huller, thrashing sweet clover seed becomes a rather undesirable job. It is now claimed, however, that some makes of grain separators, by means of special attachments or adjustments, thrash the seed successfully and hull it in the same operation.

Where the ordinary separator is used and the clover huller is not available, the seed can be hulled very satisfactorily by running it through a fanning mill and then through an ordinary power feed grinder. The average grinder will handle about 25 bushels of unhulled seed per hour. After being run through the grinder, the seed is again run through the fanning mill. The grinder hulls the seed satisfactorily and also cracks and destroys such weed seed as fox tail, which is often a very important consideration. This method, however, requires considerable labor unless the fanning mill is driven by power.

Both as a matter of convenience and for best results, the seeding of sweet clover is generally done in the spring and in a way that requires very little extra labor. The seed is sown with oats or barley, or, in some instances, on fall-sown grain such as wheat or rye. The seeding is usually done in the latter part of March or early in April. The principal reason for not sowing in the fall is that the sweet clover plants do not then have time enough to develop a strong root system and, except on sandy soil, there is much danger of winter killing.

Figure 3 (p. 12), based on data gathered throughout the central section of the corn belt, shows when the various operations with sweet clover occur, and how these different operations fit in with the work that must be done on the other crops of the region.

It will be noted that the first and practically the only labor conflict between sweet clover and the other crops of the region comes in the cutting of the sweet clover hay crop in the spring of the second year. This operation occurs in the midst of preparation of seed bed, planting, and first cultivation of corn, when each day's work is of vital importance. However, by the proper methods of securing and handling the hay, this objection loses much of its importance. Comparatively little time is required for cutting the crop and by the use of rapid methods with the side delivery rake and hay loader, as discussed under " Sweet clover for hay," page 7, the work on the sweet clover crop at this time of the year may be done without serious delay or derangement of the general labor schedule.

There is, of course, a limit to the acreage of hay that can be handled on the average farm during the latter part of May and early in June, and if the total sweet clover acreage is greater than can be put up as hay at this time, a part of the spring crop of the second year may be pastured, clipped, or plowed under. Because of the rush of work at the time when the spring crop must be handled if cut for hay, many sweet clover growers prefer to pasture the entire crop heavily in the spring and thus avoid this difficulty entirely. Clipping the crop and allowing it to lie on the ground as a means of soil improvement accomplishes the same end. Thus the labor conflict caused by cutting the spring crop for hay may be avoided and the difficulty need not be considered a serious objection to making sweet clover an important part of the farm system.

FARM SYSTEMS WITH SWEET CLOVER IN THE ROTATION.

On grain or crop farms usually a small acreage of sweet clover furnishes all the hay and pasture needed, leaving the greater part of the crop to be plowed under to enrich the soil. After the details of handling the seed crop have been worked out the sale of sweet clover seed may become an additional source of cash income. Usually in the beginning it is better practice to plow under most of the crop rather than attempt seed production, but where the seed crop can be managed properly sweet clover will serve both purposes to good advantage.

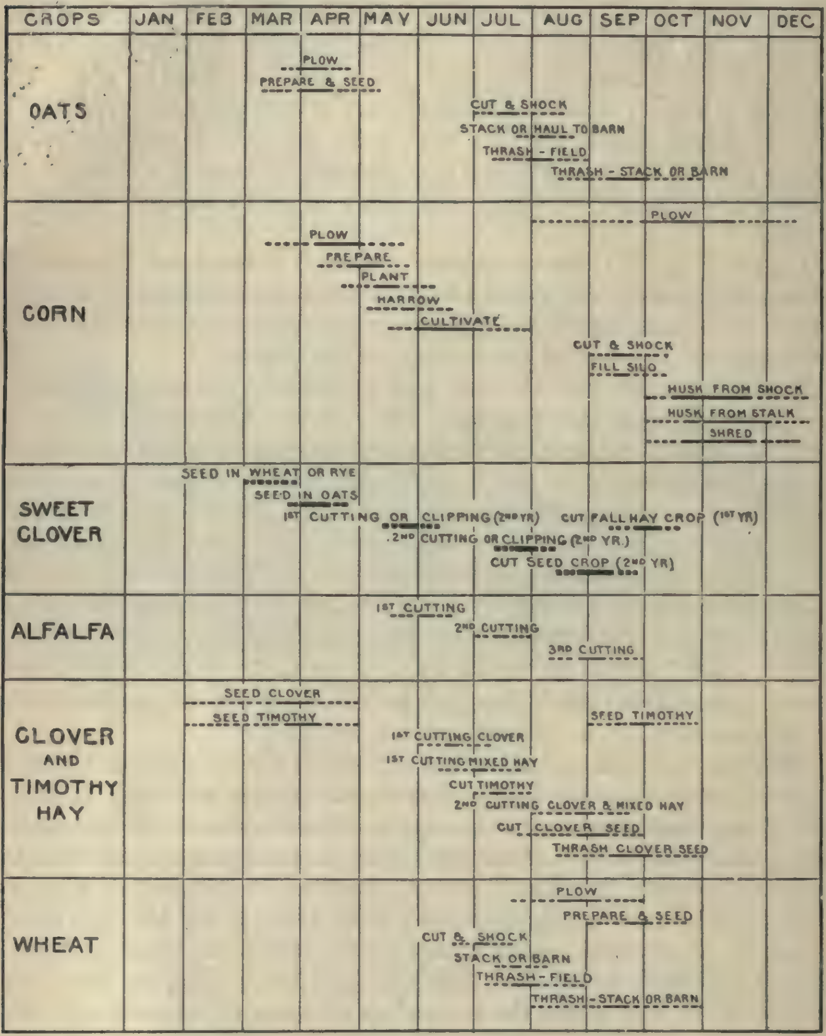


FIG. 3.—Distribution of labor as usually performed on the principal farm crops of the corn belt. The solid lines represent the average dates when the different operations are usually performed; the dots represent the extreme limits within which the work may be done.

On combination grain and live-stock farms, sweet clover serves even a better purpose. It promotes the keeping of live stock because of the hay and pasture it produces as a part of the rotation, and as a mixed seeding with bluegrass it furnishes a pasture with greatly increased carrying capacity.

TWO-YEAR ROTATIONS WITH SWEET CLOVER MAINLY AS A CATCH CROP.

A GRAIN FARM.

A good example of a two-year rotation, subject to slight variations as emergency dictates, was found in Ogle County, Ill. After some eight years of experience in farming with sweet clover Mr. W. P. Graham has worked out a very satisfactory system of this kind for three farms, which are rented out on a share basis, the rent being taken in grain delivered at the elevator. The rotation is as follows:

First year	Corn.
Second year	Small grain—oats or wheat, with a seeding of sweet clover.

This general plan is not always strictly adhered to. Occasionally corn or small grain is grown for two successive years on the same field, but in any event it is a strict rule that as soon as any part of the farm is sown to small grain it is seeded at once to sweet clover, which is pastured in the fall, if need be, but which is allowed to grow up the following spring and is then plowed under for corn. Generally speaking, corn and small grain alternate on the different fields, with sweet clover as a catch crop to be plowed under in the preparation for corn. By this plan a legume is grown in the cropping system which affords a hay crop in the fall, if desired, or its equivalent in pasture, and in the spring a heavy growth to be plowed under. The farms on which this plan is carried out, it might be added, were formerly in a very low state of fertility. By this plan, no time is lost in the production of crops for sale and the plowing under of sweet clover together with the application of phosphorous and lime is increasing production rapidly.

Formerly it was specified in the leases that a certain amount of sweet clover seed was to be produced on each farm, but the many difficulties which the tenants experienced in handling the seed crops, and the many objections which they raised to following out this program, finally forced the owner to adhere strictly to the plan of seeding all small grain to sweet clover and plowing the crop under in preparation for the following corn crop.

A serious difficulty in carrying out this system is that sweet clover must be left growing until about May 10 in order to obtain the most suitable growth for plowing under. At this time of the year the combination of dry weather and the strong sweet clover roots in the soil often makes plowing very difficult. Furthermore, when left until this date the plowing must be done quickly in order to get the corn crop planted in the proper season. Thus far it has been possible to handle this situation with horses, but it is planned to purchase a tractor for the purpose of speeding up the plowing operations on the different farms whenever necessary.

By May 10 the sweet clover crop usually attains a growth which would make practically a ton of hay per acre. This growth, together with the extensive root system which this crop develops and the nitrogen which the root nodules have gathered, has a very beneficial effect on the productiveness of the soil. For a grain farm it would be difficult to plan a better system of soil improvement than this or one that could be carried out with such little loss of time in the production of salable crops and with such small extra expense.

Figure 4 shows a general plan of the farm on which most of the work with sweet clover has been done.

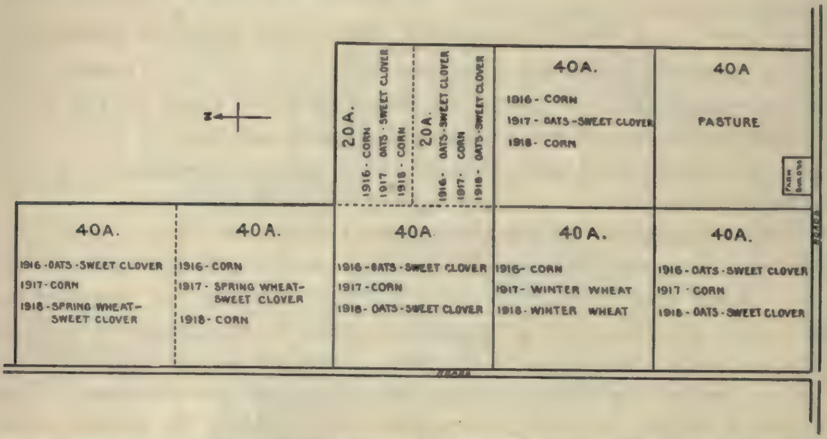

N
20 A.
1916 - CORN
1917 OATS - SWEET CLOVER
1918 - CORN
20 A.
1916 - OATS - SWEET CLOVER
1917 - CORN
1918 - OATS - SWEET CLOVER
40A.
1916 - CORN
1917 - OATS - SWEET CLOVER
1918 - CORN
40A
PASTURE
40A.
1916 - OATS - SWEET CLOVER
1917 - CORN
1918 - SPRING WHEAT - SWEET CLOVER
40A.
1916 - CORN
1917 - SPRING WHEAT - SWEET CLOVER
1918 - CORN
40A
1916 - OATS - SWEET CLOVER
1917 - CORN
1918 - OATS - SWEET CLOVER
40 A.
1916 - CORN
1917 - WINTER WHEAT
1918 - WINTER WHEAT
40A.
1916 - OATS - SWEET CLOVER
1917 - CORN
1918 - OATS - SWEET CLOVER

FIG. 4.—General plan and cropping system of a 320-acre grain farm in Ogle County, Ill.

A MIXED SYSTEM.

In Lee County, Ill., there is a 360-acre combination grain and live-stock farm operated by the owner on a modified two-year rotation plan, using sweet clover in part as a catch crop to be plowed under and in part as hay, pasture, and seed. The system followed has certain characteristics of grain farming. Large quantities of oats and corn are sold, but in addition about 120 cattle and 140 hogs are bought and fed each year. The crop yields on this farm are high. In 1915 the entire corn crop averaged 77 bushels per acre by weight. The year 1917, being an exceptionally good year for oats, this crop averaged 94½ bushels per acre. Figure 5 gives an idea of the general plan of this farm and the arrangement of the fields.

It will be noted that there are irregularities in the cropping system. In some instances corn is grown twice in succession in the same field and to a lesser extent this is true of oats. Corn and oats are the only grain crops grown, and the most regular feature of the system is that all of the oats seeding is sown to sweet clover. On some of the fields the first year sweet clover is plowed under in preparation for corn, thus affording a catch crop in a two-year rotation. Each year, also, certain fields of sweet clover seeding are reserved to produce hay in the spring of the second year and a seed crop later in the fall, thus lengthening the rotation on this part of the farm from one to three or more years.

More or less pasturing is done on the sweet clover seeding, especially in the fall of the first year, after the oats crop has been harvested; but the spring crop of the second year is not pastured to any great extent. A part of the spring crop is reserved to produce hay and if the acreage is greater than is needed for hay a part of the crop is clipped and left on the field. The seed crop is produced on the acreage thus clipped or on that cut for hay. After the seed crop is harvested and thrashed the straw is made into silage and is fed to steers during the winter season. This by-product which otherwise would be wasted is turned into good profit by this process.

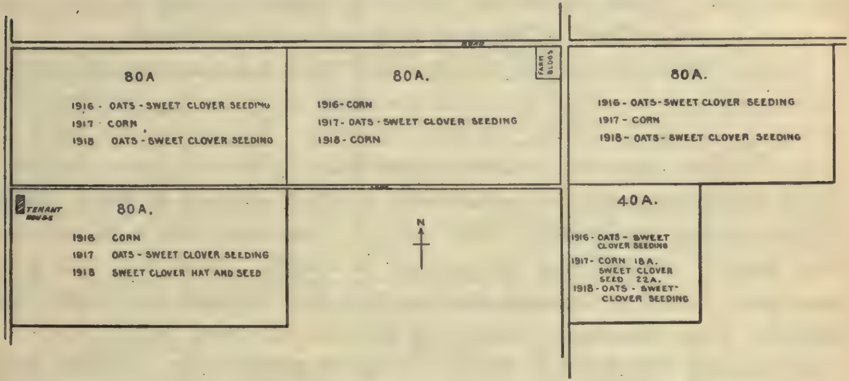

80A
1916 - OATS - SWEET CLOVER SEEDING
1917 - CORN
1918 OATS - SWEET CLOVER SEEDING
80A.
1916 - CORN
1917 - OATS - SWEET CLOVER SEEDING
1918 - CORN
FARM BLDGS
80A.
1916 - OATS - SWEET CLOVER SEEDING
1917 - CORN
1918 - OATS - SWEET CLOVER SEEDING
TENANT HOUSE
80A.
1916 CORN
1917 OATS - SWEET CLOVER SEEDING
1918 SWEET CLOVER HAY AND SEED
N
40A.
1916 - OATS - SWEET CLOVER SEEDING
1917 - CORN 18A. SWEET CLOVER SEED 22A.
1918 - OATS - SWEET CLOVER SEEDING

FIG. 5.—Plan of a 360-acre grain and live stock farm run with sweet clover as the only grass crop (Lee County, Ill.).

THREE-YEAR ROTATION WITH SWEET CLOVER FOR PASTURE, HAY, AND SEED.

A GRAIN AND LIVE-STOCK FARM.

Some very successful and effective work in the growth of sweet clover as a farm crop has been done by Mr. Frank Coverdale, of Clinton County, Iowa. The early experimental work dates back approximately 21 years, and for about 20 years sweet clover has been grown extensively as one of his main crops. After the preliminary work a general system was formulated which conforms roughly to a three-year rotation as follows:

First year__________	Corn.
Second year________	Oats, barley, or spring wheat, with a seeding of sweet clover and timothy.
Third year__________	Sweet clover and timothy.

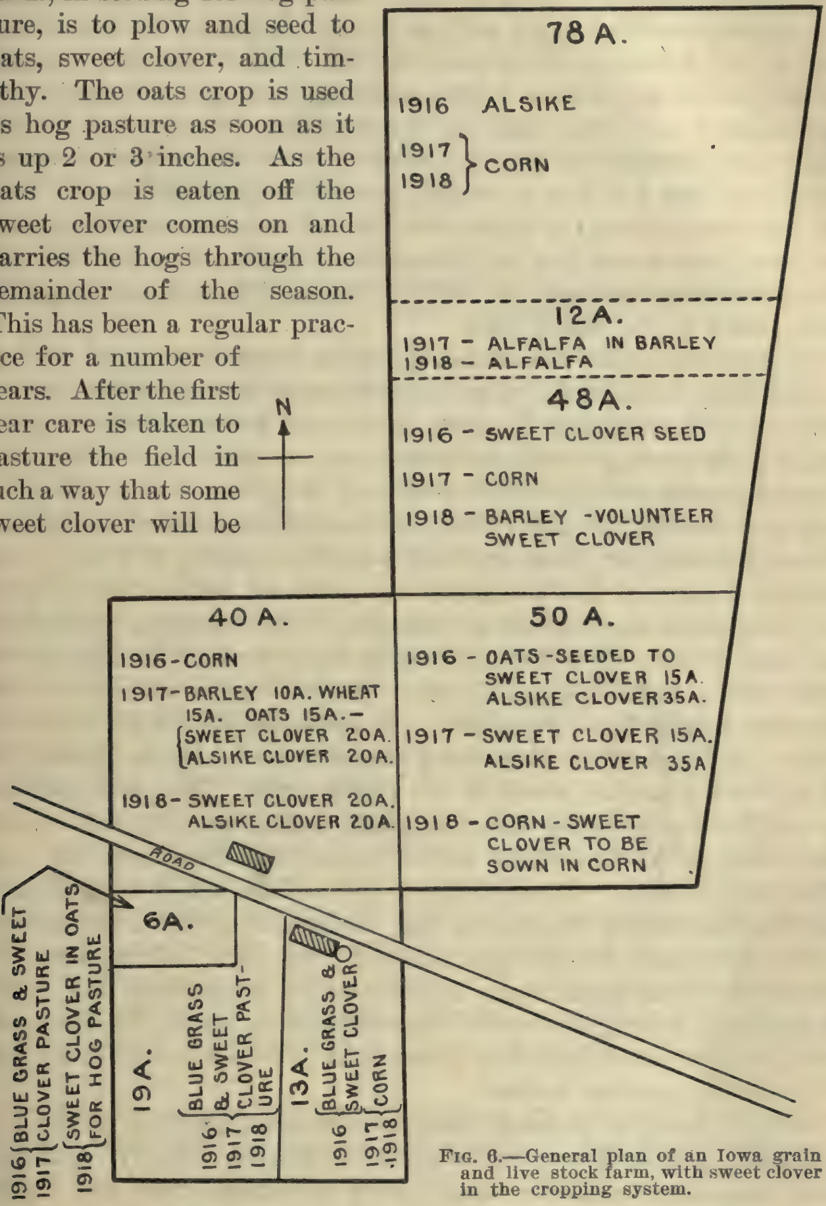
The field in sweet clover and timothy is often pastured for several years before the rotation is repeated, but in some instances the rotation is continued regularly. While a field is being pastured, the pasturing is so regulated that sweet-clover seed is produced and seed crops cut; thus when the land is returned to small grain again there is generally enough shattered seed in the ground to produce a volunteer seeding of sweet clover. Usually a seeding of timothy is made with the small grain, but after a field has once been put in condition to grow sweet clover, having been limed and inoculated, the owner of this farm generally relies on the volunteer crop to furnish a stand of sweet clover. This is feasible, however, only in a short rotation like this, in which sweet clover is allowed to go to seed on the land from year to year. Under most conditions it would doubtless be taking an unwarranted chance to follow this plan, since the cost of seed is not a very important item of expense in growing sweet clover.

On this farm, in seeding sweet clover with a grain crop, 20 pounds of sweet-clover seed per acre and 6 pounds of timothy are sown. The sweet-clover seed sown is grown on the farm. It is hulled but not scarified. The owner freely acknowledges that if the seed were scarified a much smaller amount per acre would produce equally as good results. When seeding sweet clover with oats the oats are sown with a broadcast seeder. After that the ground is double disked and the grass seed sown, the sweet clover and timothy seed having previously been mixed. Then the field is harrowed to cover the seed lightly.

In seeding sweet clover on old bluegrass pasture the common practice on this farm is to break up the pasture and sow sweet clover and timothy without a nurse crop. This method on parts of the farm is giving a fairly good stand of sweet clover on old pastures without liming, but much better results are obtained after lime is used. On fields that have grown general farm crops for several years, liming is absolutely necessary. On such fields there is a good stand of sweet clover where lime has been applied and no stand whatever where there is no lime.

The farm is run as a grain and live-stock farm, though the live stock features generally predominate. Following is the average amount of live stock kept: Horses, 8; colts, 4; cows, 5; calves, 5; brood sows, 30; shoats, 180; and feeding or grazing steers, 60. The brood sows which raise only one litter of pigs, the spring litter, are kept only one season, being fattened after the pigs are weaned, and sold, usually by the latter part of August. As a side line 300 stands of bees are kept which produce large quantities of honey from the sweet clover and from alsike, which continues to volunteer on certain fields of the farm. The general plan and cropping system are shown in figure 6.

The part of the farm south of the road is devoted mainly to the hog industry, although the hogs at different seasons of the year have access to other parts of the farm also. In 1917 the hogs were given the fields in sweet clover and bluegrass as pasture, and the 13-acre field was in corn, which was hogged down. The process usual on this farm, in seeding for hog pasture, is to plow and seed to oats, sweet clover, and timothy. The oats crop is used as hog pasture as soon as it is up 2 or 3 inches. As the oats crop is eaten off the sweet clover comes on and carries the hogs through the remainder of the season. This has been a regular practice for a number of years. After the first year care is taken to pasture the field in such a way that some sweet clover will be allowed to go to seed, but after the second or third year the field is generally reseeded again, since hogs graze so close that it is not always possible to allow enough of the crop to go to seed


78 A.
1916 ALSIKE
1917 } CORN
1918
12 A.
1917 – ALFALFA IN BARLEY
1918 – ALFALFA
48 A.
1916 – SWEET CLOVER SEED
1917 – CORN
1918 – BARLEY – VOLUNTEER SWEET CLOVER
N
40 A.
1916-CORN
1917-BARLEY 10A. WHEAT 15A. OATS 15A.– SWEET CLOVER 20A. ALSIKE CLOVER 20A.
1918- SWEET CLOVER 20A. ALSIKE CLOVER 20A.
50 A.
1916 – OATS-SEEDED TO SWEET CLOVER 15A. ALSIKE CLOVER 35A.
1917 – SWEET CLOVER 15A. ALSIKE CLOVER 35A
1918 – CORN – SWEET CLOVER TO BE SOWN IN CORN
ROAD
6A.
1916 } BLUE GRASS & SWEET
1917 } CLOVER PASTURE
1918 } SWEET CLOVER IN OATS FOR HOG PASTURE
19A.
1916 1917 1918 } BLUE GRASS & SWEET CLOVER PASTURE
13A.
1916 } BLUE GRASS & SWEET CLOVER
1917 1918 } CORN
FIG. 6.—General plan of an Iowa grain and live stock farm, with sweet clover in the cropping system.

to make a volunteer seeding that will keep up a good stand of sweet clover.

The system of beef production followed on this farm is an important feature of the farm system. The plan calls for the purchase of northern cattle, in part such as can be bought in the community and in part feeders on the general market. Usually the steers bought on the market weigh about 1,000 pounds each and are purchased about September 1, or a little later, but not later than November 15. These cattle are pastured on the combination sweet clover and bluegrass pasture till late fall or early winter, sometimes up to Christmas. During the remainder of the winter they are fed mainly on such roughage as straw, corn stover, hay, and sweet clover straw which has been left from thrashing the seed. In 1917 a silo was built and now silage has been added to the winter feed.

In the early spring the steers are put on sweet clover pasture from two to three weeks earlier than would be possible with other pastures. This early pasture may be sweet clover and timothy, following the small grain seeding of the previous year, but generally it is the permanent combination of sweet clover and bluegrass. No dry straw or hay is furnished the cattle while on sweet-clover pasture, though the owner realizes that some dry feed would be helpful if it were convenient to supply it. The steers are pastured, without corn, either on sweet clover and timothy or sweet clover and bluegrass up to about the time of sale, when they are put up for a week or 10 days on dry feed with a light feeding of corn. The sale takes place some time between August 1 and September 1, or approximately a year after the steers are bought, that time being chosen with a view to getting the steers on the market ahead of the range cattle. The price obtained is not the top price for fancy corn-fed cattle, but generally equals that brought by "short-fed cattle"—those that have been fed corn from 40 to 60 days. Occasionally the price comes within 10 or 15 cents per hundredweight of equaling that of the best cattle on the market, which have been fed for approximately 150 days. Considering the cheapness of the gains, made almost entirely on pasture, this unique system of handling beef cattle has considerable merit. It is possible that on the cheaper lands this plan might well be followed in keeping beef cows to produce feeders.

On this farm, as on many others where sweet clover is grown in a cropping system, there is still a place for alfalfa. In 1917, a 12-acre field was sown to alfalfa, using barley as a nurse crop, and a good stand was secured, the field having previously grown sweet clover and having received a good application of limestone. The plan now is to depend chiefly on alfalfa for hay and use the sweet clover to produce seed and pasture and to plow under as a soil improvement crop. The practice of growing sweet clover with bluegrass for pasture and seed will be continued. The owner of this farm owns several other farms and is endeavoring to get them all in line with the system used on the home farm.

FOUR-YEAR ROTATION SYSTEMS.

A HOG FARM.

In Livingston County, Ill., Mr. C. E. Stratton has adopted the following four-year rotation:

First year	Corn.
Second year	Corn.
Third year	Oats, with a seeding of sweet clover, alsike, and timothy.
Fourth year	Sweet clover, alsike, and timothy.

This farm is primarily a hog farm, and the cropping system is arranged and managed accordingly. The corn occupies one-half the land in rotation. Rape is sown in part of the corn in the last cultivation and is pastured as the corn is being hogged down in the field. The first crop is pastured to a point where clipping during the second year is unnecessary, and little, if any, seed is produced. In case it is impossible to keep the sweet clover down by pasturing, it is clipped about May 15, and, if necessary, again in July. By this method the crop is made to produce new shoots, and thus a better quality of pasturage. In clipping, and even in cutting for hay in the spring, the grain binder is used so as to cut the sweet clover at a considerably greater height than is possible with a mower, unless especially equipped. In order to make sure to avoid injuring or killing the crop, Mr. Stratton makes it a practice to clip from 12 to 18 inches high, according to the condition and growth of the crop.

In a rotation of this kind, with two years of corn in succession, very little volunteer sweet clover comes up in the oats. The owner of this farm is very certain that with such a rotation no dependence should be placed in a volunteer seeding of sweet clover, as may sometimes be done with a shorter rotation with only one year of corn intervening between the oats crops. The seed mixture as sown per acre on this farm is as follows: Sweet clover 15 pounds, alsike 2 pounds, timothy 2 pounds.

At present, alfalfa is grown for hay on 9 acres outside of the rotation, but in addition hay is often cut from the sweet clover crop late in the fall of the first year.

SWEET CLOVER WITH OATS AND WHEAT.

Another four-year rotation with sweet clover, especially to be recommended at the present time when there is need of concentrated effort in the production of wheat, provides for wheat occupying one-fourth of the crop area. The following is the plan of rotation:

First year	Corn.
Second year	Oats, with a seeding of sweet clover as a catch crop.
Third year	Wheat, with a seeding of sweet clover.
Fourth year	Sweet clover for hay and seed.

After the soil has been put in condition to grow sweet clover properly a catch crop of sweet clover for plowing under should be sown in the oat seeding of the second year in the rotation. By the time the oats crop is harvested the sweet clover will generally be so tall that some of the tops will be clipped off and harvested in the bundles of oats, and by the time the oats crop is thrashed and the plowing for wheat is started, a very good growth will be ready to be plowed under. This plan can be carried out at a very small expense of seed, and the growth plowed under is highly beneficial to the wheat crop. When sweet clover is plowed under thus in the summer, there is little if any danger of it coming up in the wheat the following year to the extent of being troublesome or injurious.

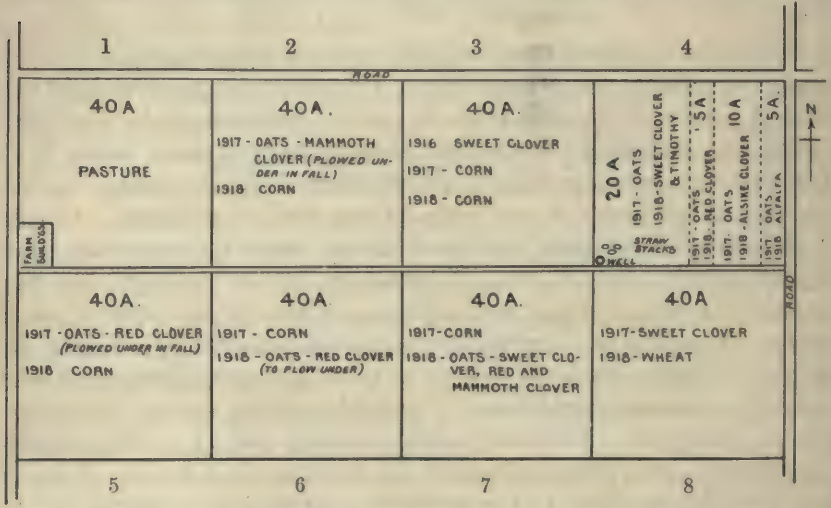


FIG. 7.—General plan of a 320-acre grain and live stock farm with sweet clover in the cropping system (Livingston County, Ill.).

In Livingston County this rotation is being carried out by Mr. H. J. Meis with considerable success. The farm proper is 320 acres in area with an addition of 80 acres of bluegrass pasture, which is located about one-half mile away, but which is run as a part and in connection with the main farm. Figure 7 shows the arrangement of the fields and the general plan of the farm proper.

There are really two cropping systems in use on this farm. The west half, being close to the farm buildings, receives all the manure produced and is run on an irregular plan without sweet clover. As yet the sweet clover is grown entirely on the east half of the farm, where no manure is applied on account of the long haul.

The present plan of arrangement is to use sweet clover principally for pasture, both in the fall after the seed crop is taken off and in the spring of the second year. The spring pasture season is usually prolonged until July 1, no hay being cut from the spring crop unless there is shortage of feed. As a rule, also, this crop is not clipped, enough live stock being kept to pasture it heavily instead, thus avoiding the danger of killing the seed crop by cutting or clipping too close to the ground. The fall crop of the second year is generally cut for seed. Sometimes, however, when feed is needed and it seems undesirable to cut for seed, this crop is cut for hay or silage when in blossom, using the grain binder, which leaves the crop in bundles, making it easier to cure and handle, and, in addition, leaving a heavy stubble to be plowed under. If sweet clover is cut while yet in blossom and before the seed forms, there is occasionally a considerable additional growth which springs up from a crop that is cut just for hay or silage. In this way this method of handling the crop affords considerable additional material to be plowed under. While the hay produced is rather coarse, horses eat it readily and clean it up with practically no waste. When put into the silos the coarser part of the hay softens and practically all of it is consumed by cattle.

The plan of having a bluegrass pasture as a separate enterprise, outside the regular rotation, and in some instances apart from the main farm, to serve as an emergency grazing ground to or from which live stock may be transferred at any time, has been found in operation on a number of farms where sweet clover is being grown. On this farm such pasture is mainly used to carry beef calves and steers and a few beef cows which are kept to produce calves, also to pasture general live stock when other pasture is poor. The cattle and general live stock usually are pastured on the main farm in the fall and early spring when sweet clover affords the greatest amount of pasturage. In this way it is possible to have an abundance of first-class pasture during the greater part of the year. Mr. Meis ships from one to two carloads of cattle annually, marketing them direct from his pastures.

The part of the main farm on which sweet clover is grown is conveniently arranged for pasturing live stock. In referring to figure 7, it will be noted that in the corner of field 4, which joins fields 3, 7, and 8, there is located a well from which live stock can be watered in each of the four fields. The oats, wheat, and the sweet clover seed crop are thrashed so that the straw therefrom will be left in the sweet clover field which is to be pastured, and generally in the corner nearest the well. It is considered very important to allow cattle to have access to a straw stack or some other form of dry feed when pasturing on sweet clover, especially in the early spring. Cattle will thus consume large quantities of straw, and it is claimed they do much better than when no dry roughage of any kind is available. Furthermore, this plan furnishes a good means of turning into profit straw stacks which might otherwise be allowed to rot.

There is another farm in Livingston County, the owner of which, after considerable experimenting with sweet clover, has adopted this same 4-year rotation system including wheat. This farm, of 310 acres, owned and operated by Mr. C. B. Meis, is run primarily as a grain farm. The owner and one man operate the farm with extra help in corn cultivation and corn husking.

By experience it has been found that on this farm, as on a very large number of farms in central Illinois, sweet clover can be grown fairly well in the slight depressions in the fields without the application of lime, while on the slight elevations and knolls it is almost an entire failure, unless lime has previously been applied. It is rather a big undertaking to apply from two to three tons of limestone per acre over the entire area of a farm as big as this one. At present, the plan adopted is to lime the higher points of each field first, and the remaining areas later. Until these slight elevations can all be limed, Mr. Meis, like many other growers in beginning with the crop, is sowing a mixture of one-half sweet clover and the other half composed of red and mammoth clover mixed. In addition to this seeding, timothy, also, is sown on the higher ground. On the unlimed elevations the stand consists almost entirely of red and mammoth clover and timothy; whereas in the depressions of the fields sweet clover holds sway almost entirely. The sweet clover is pastured as the occasion demands, but is grown mainly to supply hay for farm use and to produce seed.

A GENERAL LIVE-STOCK SYSTEM.

A good example of a four-year rotation on a live-stock farm which grows sweet clover extensively is afforded by the McHarry farm in Champaign County, Ill. This is primarily a hog farm and is unique in that the rotation differs greatly from those commonly followed in the corn belt:

First year........Corn.
Second year......Soy beans.
Third year.......Wheat, with a seeding of sweet clover and pasture mixture.
Fourth year......Sweet clover and mixed pasture.

This rotation has been worked out by a series of yearly records kept on the different crops to determine the cost of production and the net gain from each. It is planned more especially with reference to the needs of hog production, sweet clover being used mainly as a pasture crop.

The farm being 800 acres in area, it has been found impossible as yet to apply lime to all fields, although liming is being done as rapidly as conditions will permit. Sweet clover is sown in a mixture of the following proportions: Sweet clover 4 pounds, red clover 3 pounds, alsike 1 pound, timothy 2 pounds. In that way a stand of grass of some kind generally is secured each year on the entire field sown, since it is seldom that all of the crops will fail at the same time on any one part of the field.

A FIVE-YEAR ROTATION PLAN.

A rather unusual system which embodies the use of sweet clover in a five-year rotation, with alfalfa on a part of the farm set aside especially for pasture and hay, has been worked out by Mr. I. J. Gallup on his farm in Livingston County, Ill. This is one of the most thorough systems that have been found on sweet-clover farms. The farm is run on a grain and live-stock basis, with the selling of crops predominating considerably. Hogs afford the main source of income from live stock and plans are being made to increase this enterprise. The usual amount of live stock kept at present is as follows: Work horses 9, colts 3, cows 5, calves 5, sows 10, spring shoats 48, fall pigs 38.

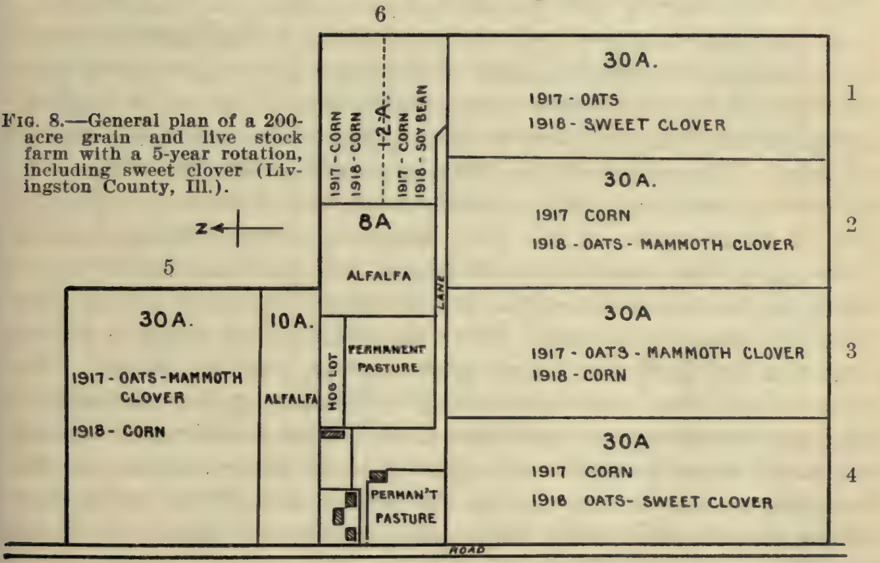


FIG. 8.—General plan of a 200-acre grain and live stock farm with a 5-year rotation, including sweet clover (Livingston County, Ill.).

The general plan of the farm and lay-out of the fields are shown in figure 8.

It will be noted in figure 8 that the main part of the farm is divided into five 30-acre fields. These fields were surveyed carefully to get exact acreage, leaving the part of the farm nearest the farm buildings for irregular fields, which are devoted to permanent pasture, alfalfa, and emergency crops. Of these smaller acreages, field 6 is devoted one-half to corn and the other half to soy beans, these crops being alternated from one side of the field to the other. The greater part of both crops is hogged off, though some of the soy beans are cut as hay for winter feeding of hogs. At the last cultivation soy beans are also sown in the corn to furnish pasturage while this crop is being hogged off. On the five 30-acre fields the following rotation is carried out:

First year	Corn.
Second year	Oats, with a seeding of mammoth clover as a catch crop.
Third year	Corn.
Fourth year	Oats, with a seeding of sweet clover with some alsike and timothy.
Fifth year	Sweet clover.

This arrangement represents a well-balanced cropping system and one that is suited either to grain or live-stock farming or to any combination of the two. As yet the greater part of the grain—oats especially—is put on the market, while a part of the corn is fed, mainly to hogs. The owner of this farm does not believe in using sweet clover as a catch crop to be plowed under, as he fears it will come up and be troublesome in the corn which follows. Though careful plowing, as has been shown elsewhere, will prevent trouble of this kind, he prefers at present to use mammoth clover as a catch crop after the second year oats. This crop of mammoth clover is plowed under in the fall rather than in the spring, and the owner's testimony is that this practice pays well in keeping up the soil fertility. If the mammoth clover sown thus is not pastured after the oats crop comes off, there is considerable growth to be plowed under. As the cropping system is carried on at the present time all of the plowing of the farm is done in the fall season and for this reason the spring work is easily managed.

Thus far it has been impossible to apply lime to the entire acreage of the farm under rotation. Hence, conditions are not altogether ideal for growing sweet clover. Sweet clover grows well without lime in the slight depressions in the different fields of the farm, but on the knolls, even on very slightly elevated ground, the stand is very poor or altogether lacking until lime has been applied. Since these high spots are not numerous it has been a question whether to go to the expense of liming in order to have the entire acreage prepared for growing the sweet clover. The owner, for the present at least, will adopt a plan of liming the higher elevations first. Until these elevations have been limed the plan is to sow a mixture of sweet clover 10 pounds, alsike 6 pounds, and timothy 6 quarts per acre. In this way a stand of grass is secured over the entire area sown. In the low grounds sweet clover is the principal crop, while alsike and timothy are more in evidence on the elevations.

On this farm the sweet clover and mixed seeding generally are used for pasture in the fall after the oats crop is taken off. In the spring of the second year a hay crop is cut and the second crop is harvested for seed. The owner of this farm has had considerable experience in the production of seed and has his harvesting machinery fairly well equipped with pans and extra attachment for catching the seed which shatters while cutting the crop. He is strongly of the opinion that the beginner will do well not to try to produce a seed crop at first.

GROWING SWEET CLOVER FOR SOIL IMPROVEMENT ONLY.

There are a number of instances where farmers in the corn belt grow sweet clover for the express purpose of soil improvement on certain fields but do not care to make the crop a part of the regular farm system. In this case the end in view is to provide the greatest possible amount of nitrogen in the soil and vegetable growth to be plowed under. It is clear that the second year crop which would otherwise be devoted to seed production will give the greatest growth for soil improvement, but there are difficulties in plowing under this crop which must not be overlooked, as certain special methods of procedure are usually necessary.

At Rochelle, Ill., in the fall of 1917 it was found that a certain field of sweet clover had failed to mature a profitable seed crop and it was decided to plow it under with a 4-horse team and gang plow. The growth, however, was so heavy and woody that the team could not be driven through it except with the greatest difficulty. The knees of the horses soon became raw and little progress was made. An attempt was then made to flatten the sweet clover down with a roller but still the same difficulty arose. Finally by crowding the team close into the standing sweet clover it was found that a narrow strip could be rolled down without forcing the horses to penetrate the standing growth. This process, however, was very slow. The field was finally plowed, but with extreme difficulty and the farmer who had the disagreeable experience will hereafter avoid any such undertaking.

If sweet clover is produced merely with the idea of getting a large amount of growth to be plowed under, and, if it is necessary to do the plowing with teams, a different method should be adopted. The fall crop of the first year may be cut for hay without lessening to any great extent the amount of material finally returned to the soil. About the middle of May the second year crop may be clipped from 8 to 12 inches high and allowed to remain on the ground. In order to prevent too heavy a growth the crop may be clipped again early in July, this time from 12 to 18 inches high if possible. This clipping also remains on the field. After the second clipping, considerable growth and some seed will be produced, all of which, together with the two clippings, may be plowed under later in the fall without special difficulty.

When a tractor is available, however, clipping is unnecessary, and if the proper equipment is used a very heavy growth of the fall crop of the second year can be plowed under very satisfactorily. On several occasions large acreages of sweet clover, which have failed to produce seed, have been plowed under by the use of a tractor and gang plows with special jointers which are very effective in turning under large amounts of vegetable matter of this kind.

SWEET CLOVER IN BLUEGRASS PASTURES.

The combination of sweet clover and bluegrass in pastures offers a number of distinct advantages. Both crops grow well together, even when there is a perfect stand of each. The sweet clover adds nitrogen to the soil and where the stand of bluegrass is poor the grass soon thickens up and produces a much better stand than it would without sweet clover. Furthermore, the sweet clover adds greatly to the total amount of pasturage produced and gives a longer pasture season. It comes on in the spring two to three weeks earlier than most other grasses and the live stock can be turned out to pasture just that much sooner than otherwise would be possible. In some instances this combination has more than doubled the carrying capacity per acre of bluegrass alone. A first-class pasture of this kind will more than carry two 1,000-pound steers per acre in the spring and early summer, and, as a usual thing, will carry more than one such steer per acre during the remainder of the pasture season.

If not pastured too heavily the sweet clover will produce seed enough to re-seed the pasture, and often a crop of from 3 to 8 bushels of seed can be harvested per acre in addition to the pasturage produced throughout the season. The experience of a few men is that when such a combination pasture is handled in this way it will maintain itself from year to year and it is unnecessary to sow any great amount of seed to keep up the sweet clover in combination with bluegrass.

The pasture shown in figure 9 is a good example of a sweet clover and bluegrass combination. There is a perfect mat of bluegrass in addition to the sweet clover, and both crops make a vigorous growth. This pasture is located along a railroad and is used for pasturing western sheep that are unloaded and held for a period before shipping on to the Chicago markets. The number of animals on this pasture varies greatly and it is difficult to get an estimate of its carrying capacity, since it is not pastured up to its full capacity all of the time and the sheep do not keep the sweet clover down. Even after it has grown up, and after seeding has become dry, they continue to reach up and eat off the branches.

A splendid example of this sweet clover and bluegrass combination pasture is found in Ogle County, Ill., in a tract of 320 acres in area, which is run as an enterprise separate from three farms which the same owner rents out on a grain basis with sweet clover in the cropping system as a catch crop. This pasture has never been plowed. In getting a stand the owner simply sowed sweet clover seed broadcast on one-half of the pasture one year and on the other half the next. It was pastured constantly as if no seeding had been made and a good stand was secured in both instances. As a result of the seeding having been done on alternate years, one-half of the field produces a seed crop while the other half produces the first-year growth of sweet clover preparatory to producing a seed crop the next year. After the early spring the live stock are induced to graze principally on the half of the pasture that is not producing seed, which permits the seed crop to develop comparatively unmolested.

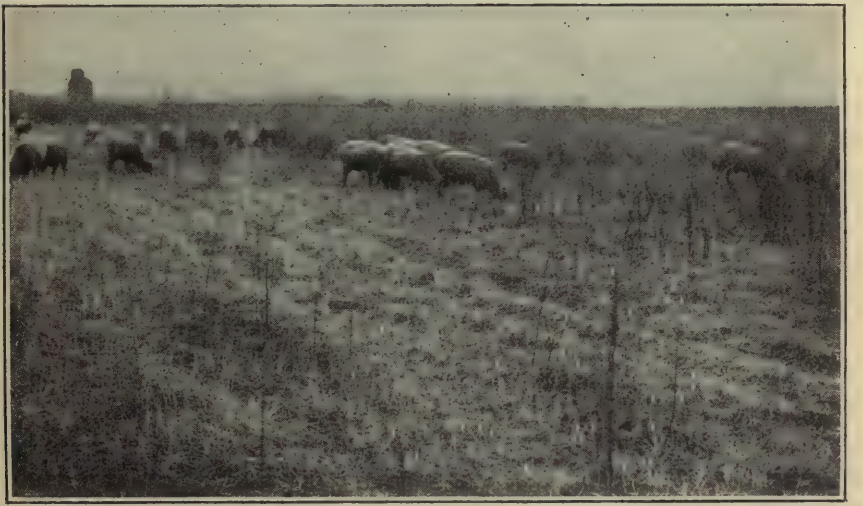


FIG. 9.—A valuable combination of sweet clover and blue grass pasture (Ogle County, Ill.).

A farmer of Clinton County, Iowa, has had unusual success in the seeding of sweet clover in one of his worn-out fields that had been cropped with corn and oats continuously for about 40 years, mainly without being seeded to grass. Sweet clover was sown with timothy, and bluegrass came in, so that in a few years there was a perfect stand of sweet clover and bluegrass. After many years the field still produces annually an extremely luxuriant growth of this pasture combination. The pasturing has usually been done with sufficient care to permit the sweet clover to produce some seed each year. A seed crop is cut, in addition to the pasturing, and enough seed shatters off to reseed the field from year to year. Under this system of management it has been found necessary to sow but little sweet clover seed to keep the stand in good condition. No manure or fertilizers have been applied, but the pasturing of cattle and the nitrogen produced by the sweet clover have built the field up from extreme depletion until its carrying capacity is fully double that of the average bluegrass pasture of the neighborhood.

In establishing a combination sweet clover and bluegrass pasture the problem of getting a stand, as compared with the growth of sweet clover in rotation, is fundamentally different. In some instances the pasture must be plowed, limed, and seeded anew.

On old bluegrass pastures of long standing, which still have a fairly good lime supply, a stand of sweet clover often can be secured simply by sowing the seed late in March or early in April and allowing live stock to tramp the seed into the ground. In other instances it is more convenient to start such a pasture on a part of a rotation area, a seeding of sweet clover and timothy being made in the oats after the necessary application of lime, the bluegrass being allowed to come in of its own accord.

To determine the method that will succeed in getting a stand of sweet clover and bluegrass for pasture, it will generally require some experimenting, as local conditions vary greatly.

Perhaps there is no use for sweet clover that gives such promise and that seems to lend itself to such wide application as this combination of sweet clover with bluegrass for pasture. It produces a pasture of such quality and carrying capacity as to make it profitable generally even on high-priced land. On cheaper lands this combination can easily be made a valuable asset as a general pasture, and, in addition to reducing the cost of keeping all branches of live stock, can well be made an important factor in economic and profitable beef production.

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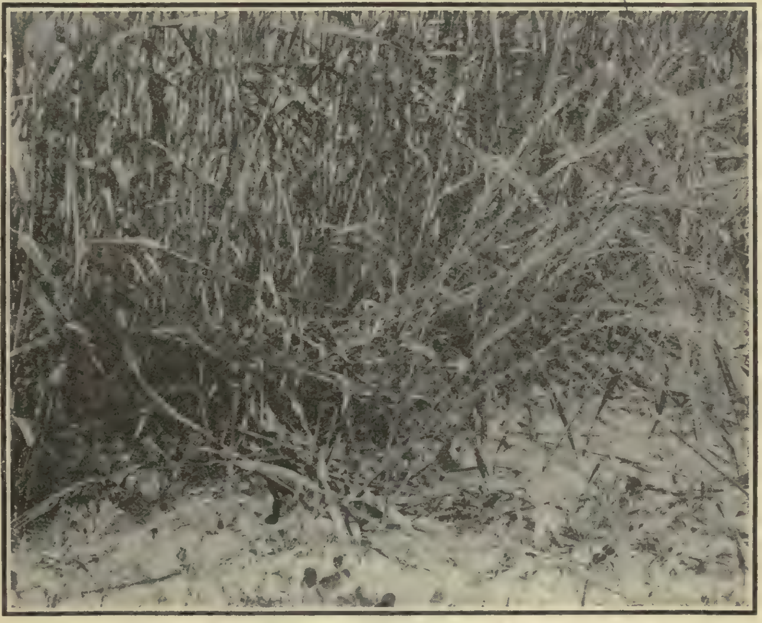
THE WHEAT JOINTWORM AND ITS CONTROL

W. J. PHILLIPS
Entomological Assistant, Cereal and Forage
Insect Investigations

Revised Sep '40



Straw-fallen wheat—injury caused by the wheat jointworm

FARMERS' BULLETIN 1006
UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from the Bureau of Entomology
L. O. HOWARD, Chief

Washington, D. C. October, 1918

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THE WHEAT JOINTWORM ranks next to the Hessian fly as a wheat pest in the majority of the wheat States east of the Mississippi River and in parts of Missouri. At present, however, absolutely nothing is being done to control it. In fact, the present farming practices and systems of rotation afford it ideal breeding conditions.

This jointworm can be controlled in Virginia, Tennessee, and Kentucky by plowing down wheat stubble deeply after harvest wherever this is practicable and does not interfere with the growing of red clover and grasses. Rye may be substituted with safety for wheat in the more northerly States, such as Michigan, where jointworm injury is severe, because it is not subject to attack by this jointworm. Rye is a good bread grain, cover crop, green manure, and nurse crop for clover.

THE WHEAT JOINTWORM[1] AND ITS CONTROL.

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WHEAT JOINTWORM AND HESSIAN FLY.

The wheat jointworm is a very small grub which lives in stems of wheat, sucking the juices of the plant and causing a swelling in the stem. The egg from which it hatches is laid in the stem by an insect resembling a small black ant with wings. This insect attacks no other kind of plant. The injury which it does to wheat is very distinct from that caused by the Hessian fly, yet the depredations of these two insects are often confused by farmers. This paper is intended, therefore, to give a brief outline of the life history and the

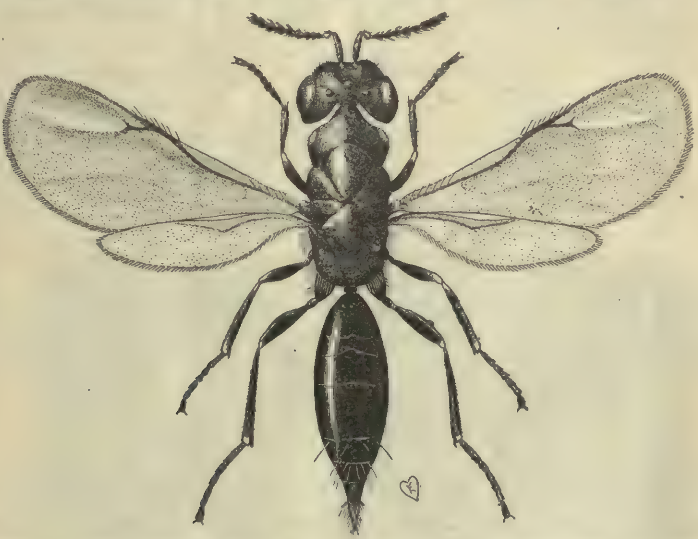

FIG. 1.—Adult female of the wheat jointworm. Greatly enlarged. (The head is tilted back somewhat so as to show the groove in front.)

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[1] (*Isosoma*) *Harmolita tritici* Fitch.

nature of the injury to the plant by the jointworm so that any farmer may readily recognize its work and be able to apply the measures of control herein recommended.

STATES IN WHICH WHEAT JOINTWORM DAMAGE OCCURS.

The wheat jointworm (fig. 1) occurs in more or less destructive abundance in all of the more important wheat-growing States east of the Mississippi River. (Fig. 2.) It has also crossed the Mississippi into the eastern half of Missouri, where it is causing considerable damage to the wheat crop, and it has been found in the extreme southeastern part of Iowa. This insect undoubtedly occurs to a greater or less extent wherever wheat is grown east of the Mississippi River. That portion of the great wheat belt lying west of the Mississippi River, excepting the limited areas just mentioned, thus far has escaped its ravages, and the insect has never even been found in that region excepting in Missouri.

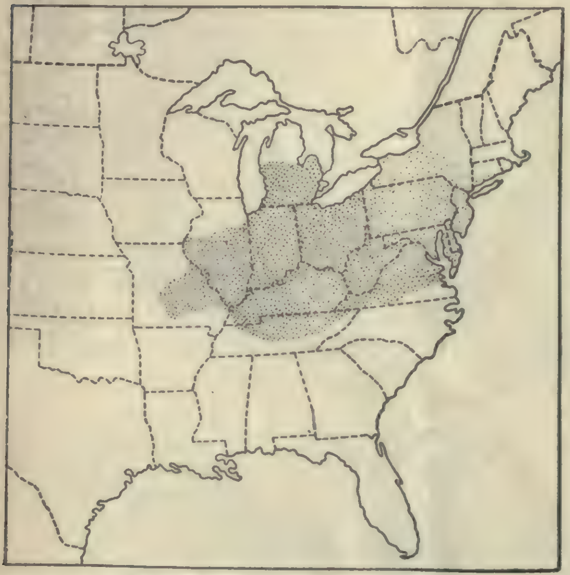

FIG. 2.—Map showing present known distribution of the wheat jointworm in the United States.

ECONOMIC IMPORTANCE.

In destructiveness to wheat the jointworm ranks next to the Hessian fly within the States involved, the damage running into millions of bushels. Without a doubt it surpasses that insect in destructiveness during some years, from the very fact that the farmers generally have learned in a measure how to control the depredations of the Hessian fly and are applying this knowledge to a considerable extent. The opposite is true for the jointworm, as little or nothing is being done by the farmers to control this pest. In fact, the present practices and systems of rotation furnish ideal conditions for its development.

NATURE OF INJURY.

Fortunately for all concerned, this jointworm never attacks any plants other than wheat, and this greatly simplifies control measures.

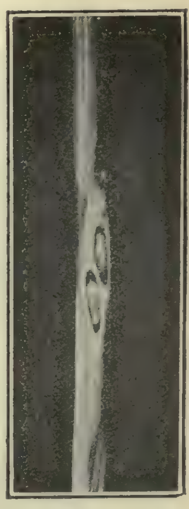

FIG. 3.—Wheat jointworm cells opened, showing the mature larvæ. About natural size.

When a wheat plant has become infested, no outward sign whatever may appear. The presence of the jointworm can be detected when the plant is nearly mature, however, by pinching the plant between the forefinger and the thumb. Infested plants will be found to contain a hard, woody place in the stem just above the second or third joint from the ground, or there may be several such places. If these hard places be chipped with a sharp knife, larvæ or grubs will be found inside the stem in distinct little cells or cavities (fig. 3).

Very often the point of infestation is very noticeable, there being wartlike swellings (fig. 4) on the stem. Another very good indication is the presence in the field of a number of fallen or lodged plants. This can be readily observed from a distance, and the condition is often attributed by farmers to the work of the Hessian fly. A close examination of these fallen plants, however, will show hard, woody galls at the point where the plant bends over (fig. 5). When a plant breaks over from Hessian-fly attack, no such woody, hard place in the straw will be found, and near the bend or break there will be found either

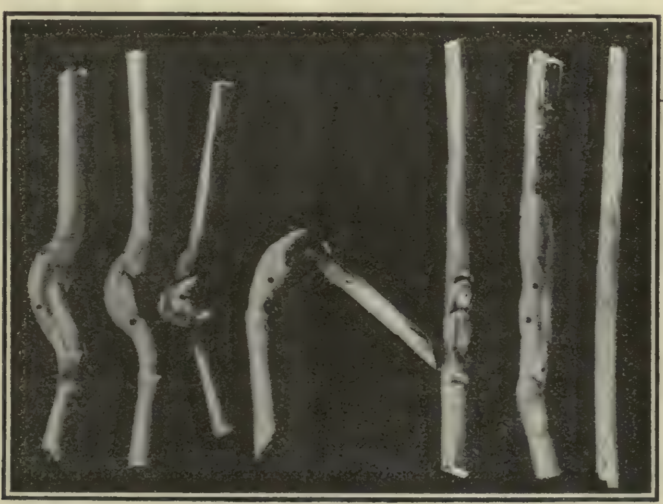

FIG. 4.—Sections of wheat stems, showing typical galls or injury from the wheat jointworm. About natural size.

greenish-white, footless grubs or flaxseed-like objects between the leaf sheath and the main stem.

The damage to a field by the jointworm may vary from slight injury to total destruction. In the latter case practically all the plants fall. Figure 7 and the title-page illustration show distant and close

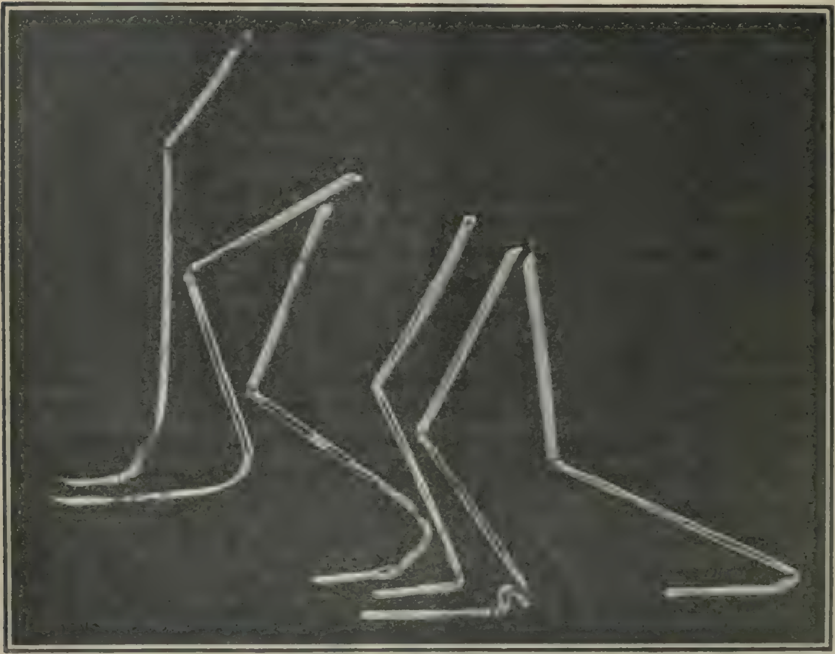

FIG. 5.—Typical fallen straws infested by the wheat jointworm, showing the angle at which they bend over. Considerably reduced.

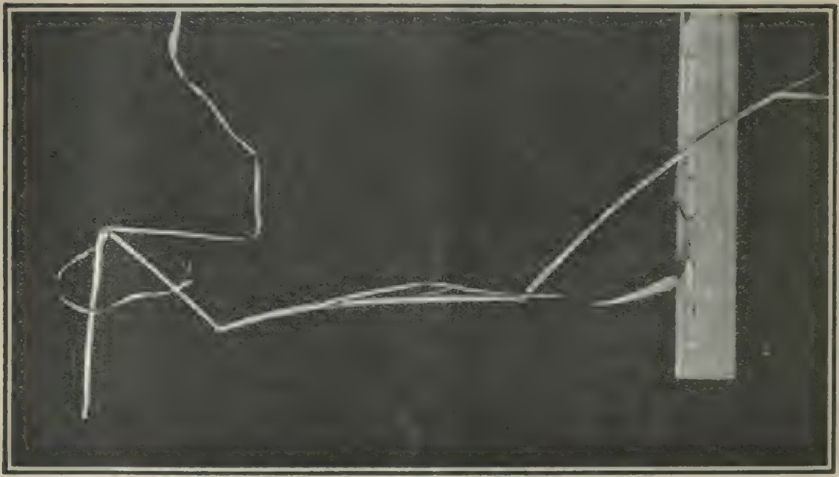

FIG. 6.—Showing point at which the fallen straws resulting from wheat jointworm attack are cut by the binder. Considerably reduced.

views, respectively, of badly lodged wheat. When such wheat is cut by the binder the fallen plants are cut just below the head (see fig. 6), and thus the heads are lost, as they will not be bound in the bundle or sheaf, and should they be bound the necessary subsequent handling will cause them to be lost from the butts of the bundles.

It is not necessary, however, for large numbers of the plants to lodge or fall to reduce the yield greatly, especially if the percentage of infestation is high. The hardened, knotty places in the wheat stems interfere with the normal flow of the sap and the proper nourishment of the developing kernels, leaving them not only lighter in weight but also considerably smaller in size.

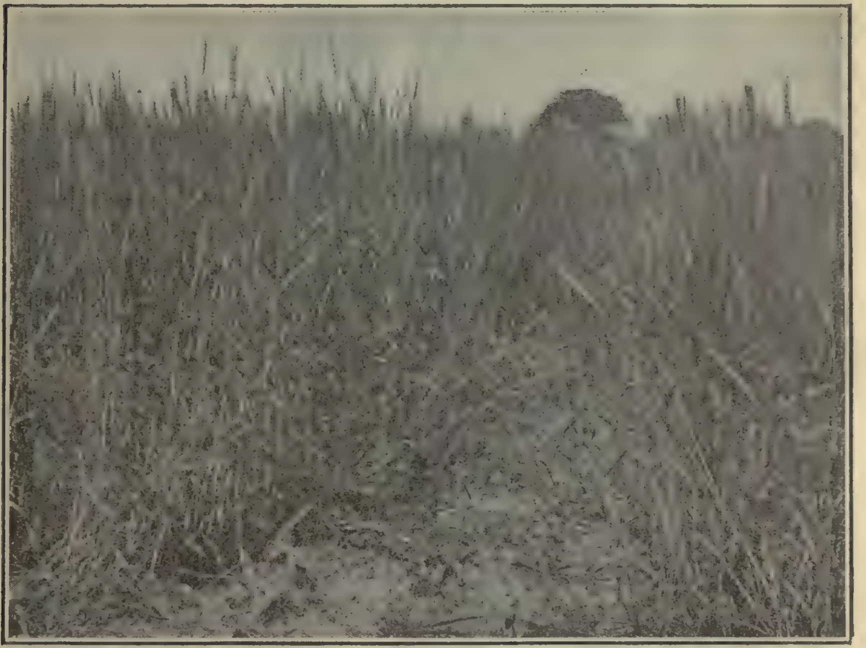

FIG. 7.—A badly infested and straw-fallen wheat field. Injury caused by the wheat jointworm.

Figure 8 shows the actual yield of grain from 85 heads from healthy plants in comparison with that from 85 heads of equal length from plants with one and two points of infestation, respectively, and with that from 85 heads of equal length from infested plants that were lodged or fallen. Strong, vigorous wheat is not injured proportionately as severely as poorer wheat, and this is shown by the yield from 85 heads from infested and uninfested plants from good and poor wheat (figs. 9 and 10). In the latter case all the heads were not of equal length, and the average yield per head was taken for the infested and uninfested from both the good and the poor wheat to show the relative difference. The heads were carefully measured and the grain was thrashed very carefully by hand, not a kernel being left in the heads. The difference in weight is fully as great as the difference in bulk. This is conclusive proof that even when the plants do not fall or lodge, great injury is done when the degree of infestation is high.

SEASONAL HISTORY.

Like many other insects, the jointworm has four stages in its life history, namely, the egg, the larva or grub, the pupa or resting stage, and the adult or parent insect. There is only one generation a year.

THE EGG.

The eggs (fig. 11) are very small, white, and shaped somewhat like a cherry before they are laid. They are pushed down into the wheat stem (fig. 12), one in a place, with a sharp, needle-like ovipositor. Sometimes as many as 15 eggs are pushed into the stem within a space of about 1½ inches. Egg laying occurs shortly after the emergence, during May, by the adults which develop from the larvæ that have overwintered in the stubble. They are laid only during the day and one female may deposit as many as 70 or more eggs. The eggs hatch in about 14 days, more or less, depending upon whether the weather is cool or hot.

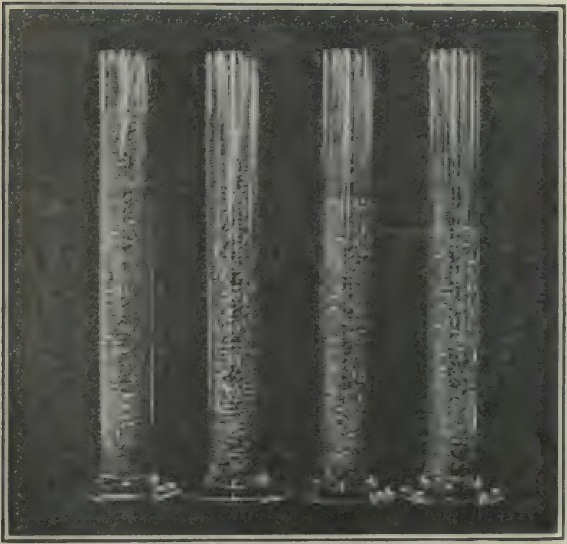

FIG. 8.—Difference in yield from 85 heads from healthy plants (left to right), and the same number from plants infested by the wheat jointworm at one internode, those infested at two internodes, and from fallen straws, respectively. Though all of these heads were the same length, the difference in yield is marked.

THE LARVA OR GRUB STAGE.

The larvæ at the time of hatching are very minute, whitish, translucent little creatures, and they never move from the point in the stem at which they hatch. These grubs are footless and are provided with tiny hooks or mandibles with which they lacerate the tissues of the plant and then suck the juice. By the time the larvæ hatch there is a distinct disturbance in the tissues of the plant and within about a week or two after hatching a cell has formed about each larva. These cells disarrange the tissues of the wheat stem and consequently weaken the stalk at that point. A rain or wind storm at this time will cause the plants to bend at the point where the cells are, and thus badly infested fields often become badly lodged.

The larvæ reach maturity and stop feeding just before the wheat ripens. At this time they are of a yellowish color and about three-sixteenths of an inch long (fig. 13), occupying a neat little gall or cavity in the walls of the stem, and the stem at this point is very hard and woody.

When the wheat is cut the stubble is left about 7 inches tall and the majority of the larvæ remain undisturbed in the old stubble. As clover and grass are often sown with wheat, the old stubble is left standing for nearly a year, thus furnishing ideal conditions for the development of this pest.

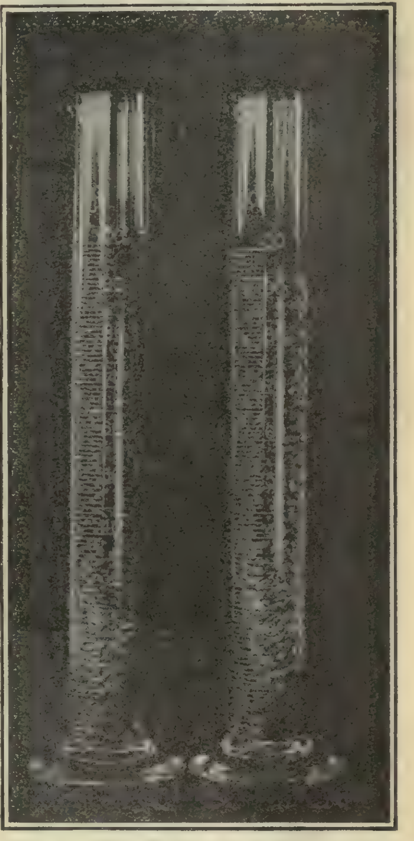

FIG. 9.—Yield from 85 healthy plants (at left) and from 85 jointworm-infested plants from strong, vigorous wheat. Note the relatively greater damage done to poor wheat as shown in figure 10.

THE PUPA OR RESTING STAGE.

The larvæ remain in the old stubble and in November and December about 90 per cent of them change to pupæ (fig. 14). The pupa is about three-sixteenths of an inch in length and at first is of a pale yellow color, gradually changing to a dirty yellow. It remains the latter color until spring and then changes to black. The pupa does not feed on the plant, but remains in the old stubble over winter. In May it changes to the adult, gnaws a small circular hole in the stem, crawls out, and flies away in search of growing wheat.

Large numbers of the pupa are killed each winter in the Northern States by the severe cold, but this also seems to kill about the same proportion of its insect parasites, and as a rule little difference can be noted the following year in the percentage of infestation.

THE ADULT OR PARENT.

The adult insects (fig. 1) usually escape the observation of the average farmer, for they are very small and are not abroad in the fields longer than from about 10 days to 2 weeks during the year. They are about three-sixteenths of an inch long, black, with four delicate, transparent wings and somewhat resemble winged ants. The jointworm does no damage to the wheat in this stage. As soon as the adults emerge from the old stubble they start in search of growing wheat, and although apparently they are not strong fliers they may be carried a mile or more by the wind, which is the chief agency in disseminating these creatures. A space of a few hundred yards therefore between an old stubble field and growing wheat is no protective barrier whatever.

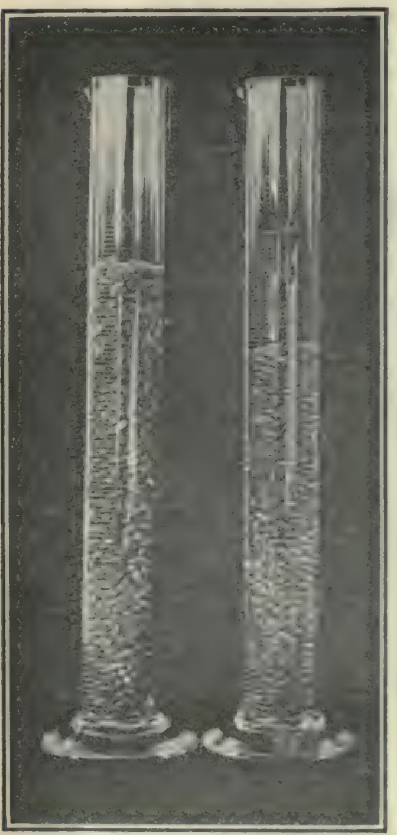

FIG. 10.—Yield from 85 healthy plants (at left) and from 85 jointworm-infested plants from poor, weak-growing wheat. Note the relatively greater injury to this poor wheat than to strong, vigorous wheat as shown in figure 9.

HISTORY OF THE WHEAT JOINTWORM IN THE UNITED STATES.

The wheat jointworm is a very old enemy of wheat. The first record of its appearance was in 1821, when it was observed in Bucks County, Pa. The earliest outbreak on record was in 1848, in the vicinity of Charlottesville, Albemarle County, and Gordonsville, Orange County, Va. In 1851 the wheat of Albemarle County was scarcely worth harvesting. In 1854 the outbreak had assumed such alarming proportions that a "jointworm convention" was called in Warrenton, Fauquier County, Va., to consider the best means of controlling the ravages of this pest.

By the early eighties this insect had become very widespread, causing considerable injury to wheat in Virginia, Ohio, Michigan, and New York. Again in the nineties it claimed serious attention, and during the last 15 years the jointworm has caused constant and serious loss to practically all the main wheat-growing States east of the Mississippi, and for some years has been causing serious loss in southeastern Missouri. At present it is known to have reached nearly across the southern part of this State. For reasons as yet imperfectly understood it has not established itself elsewhere west of the Mississippi River.

NATURAL ENEMIES.

Without the assistance of numerous parasitic enemies of the jointworm, wheat growing in the Eastern States of necessity would have been abandoned or the growers forced to adopt effective methods of control. The parasites have made it possible usually for the majority of wheat growers to grow fair crops of wheat in spite of the jointworm. But these friends of the wheat farmer can not be relied upon always by any means, as the writer has seen infested fields which yielded only 6 or 7 bushels to the acre as an average.

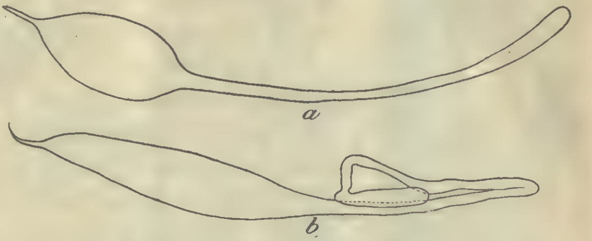

FIG. 11.—Wheat jointworm eggs: *a*, Before oviposition; *b*, after the egg has been pushed down into the plant tissues.

At present three parasites deserve special notice. All are minute four-winged flies in the adult or parent stage, and about the same size as the adult of the jointworm. One (fig. 15) is dark brownish and has three or more generations a year. The eggs are pushed down into the hiding places of the jointworms, and when the young grub hatches from the parasite egg it devours the jointworm. The last generation of the parasite passes the winter as larvæ or grubs in the cells of the hardened pieces of straw of the old wheat stubble and emerges in the spring after the jointworm has begun its development. A second species of parasite (fig. 16) in the adult stage is bluish black and has a life history approximately the same as the preceding, with the exception that there are four or more generations a year, at least in the more southern States. The third (fig. 17) is black, and the average person can not distinguish it from the adult of the jointworm. It differs markedly in life history from the other parasites in that it deposits its egg when the jointworm is only about a fifth grown.

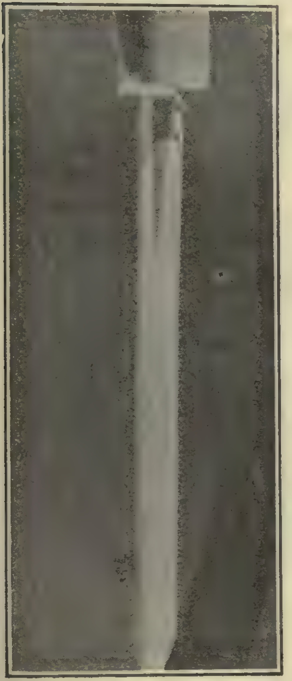

FIG. 12.—Adult wheat jointworm pushing egg down into plant stem. About natural size.

When it hatches the larva devours the jointworm and completes its development on the plant tissues. While the insect actually lives for a part of its life at the expense of the wheat plant, it is entirely dependent upon the jointworm for starting its development and is therefore as truly beneficial as the other species. It also remains in the old stubble over winter as a grub.

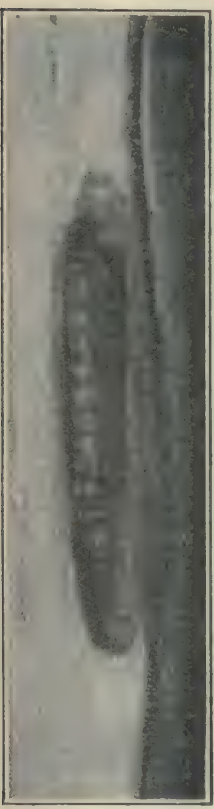

FIG. 13.—Full-grown larva or grub of the wheat jointworm. Considerably enlarged.

There are numerous other parasitic and predacious enemies of the jointworm that play a part in its control, but the three parasites previously mentioned are at present by far the most important. *Wheat growers should be warned not to depend upon these insect parasites to prevent jointworm injury to the crop, but to practice consistently the remedies hereafter recommended.*

CONTROL MEASURES.

As previously stated in this bulletin, little or nothing is being done to control the jointworm, and the prevailing methods of farming throughout the region infested by it tend to permit increase of injury rather than control of insect pests, such as the jointworm, Hessian fly, and wheat sawfly, that live from year to year within the wheat stubble.

CONTROL BY CULTURAL METHODS.

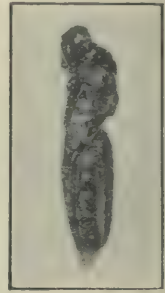

FIG. 14.—Pupa or resting stage of the wheat jointworm. This is the stage in which most of the jointworms pass the winter in the old stubble fields.

The joint worm can be controlled by plowing under wheat stubble after harvest during the summer or early fall, thus burying the stubble containing the pest so deeply as to prevent the emergence of the insect the following spring. But this method should be practiced only where it will not interfere with the growing of clover and forage grasses which are so necessary in maintaining the tilth of the soil.

Where the foregoing method is adopted all badly infested wheat should be cut high. If the wheat be tall and vigorous, the stubble should be left about 10 inches high. In other words, all badly infested wheat should be cut as high as practicable with the ordinary binder, so that the great majority of the jointworms will be left on the field in the old stubble (see figs. 3 and 4) and may be turned under and destroyed.

In southern Kentucky, Virginia, Tennessee, and other Southern and Southeastern States, where double-cropping systems are in general use, it should be possible to plow down the stubble generally and thus easily secure control of the jointworm. Where this is done all volunteer wheat should be destroyed by disking, occasional harrowing, or in other ways, in order to prevent this and other pests from breeding in such plants. In the northern clover-growing regions this method could not be adopted without seriously interfering with clover culture, and should be employed only in cases where extraordinarily severe infestations of the jointworm threaten complete loss of the crop.

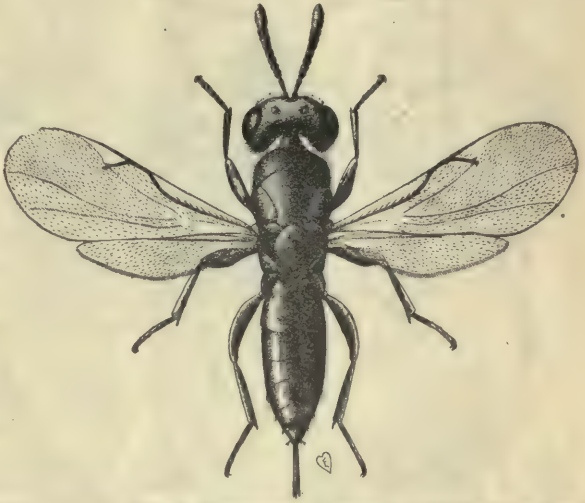

FIG. 15.—A wheat jointworm parasite, *Ditropinotus aureoviridis*. Greatly enlarged.

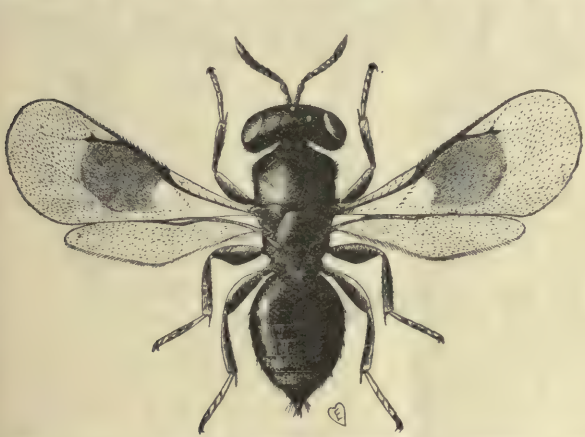

FIG. 16.—A wheat jointworm parasite, *Homoporus chalcidephagus*. Greatly enlarged.

SUBSTITUTION OF SMALL GRAINS IMMUNE TO JOINTWORM INJURY.

The wheat jointworm does not attack any crop other than wheat. Therefore it is possible to substitute with entire safety either rye, barley, or buckwheat for wheat on lands heavily infested with the jointworm. Of the three grains mentioned, rye doubtless is the most suitable substitute for wheat. It may be grown in almost any region where winter wheat will grow, is a satisfactory nurse crop for clover, and can be grown successfully on poorer

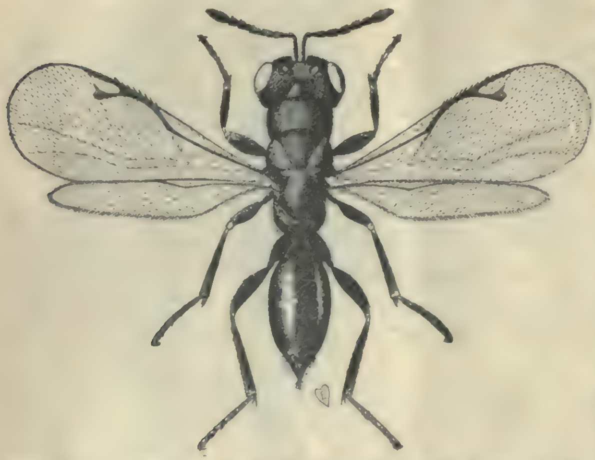

FIG. 17.—A wheat jointworm parasite, *Eurytoma bolteri parva*. Greatly enlarged.

and sandier soils than wheat, with less fertilizer. The latter fact is important, because the jointworm usually selects stands of poor wheat upon which to lay its eggs, and jointworm injury is therefore more frequent and severe in such fields than where the crop is in a vigorous condition.

Rye is a good cover, green manure, and grazing crop, and can be grown more safely in some of the Northern States than winter wheat. This is particularly true of Michigan, where jointworm injury is usually severe. Rye is not often severely injured by the Hessian fly or other important insect enemies of wheat. It is also a good bread grain, used largely by many people of this and other countries. The substitution of rye or other small grains for wheat is not recommended as a remedy for jointworm injury except where losses from this cause are of a serious nature and where it becomes absolutely necessary to adopt immediate control measures.

THE PRESIDENT TO THE FARMERS OF AMERICA

[Extract from President Wilson's message to the Farmers' Conference at Urbana, Ill., Jan. 31, 1918.]

"The forces that fight for freedom, the freedom of men all over the world as well as our own, depend upon us in an extraordinary and unexpected degree for sustenance, for the supply of the materials by which men are to live and to fight, and it will be our glory when the war is over that we have supplied those materials and supplied them abundantly, and it will be all the more glory because in supplying them we have made our supreme effort and sacrifice.

"In the field of agriculture we have agencies and instrumentalities, fortunately, such as no other government in the world can show. The Department of Agriculture is undoubtedly the greatest practical and scientific agricultural organization in the world. Its total annual budget of $46,000,000 has been increased during the last four years more than 72 per cent. It has a staff of 18,000, including a large number of highly trained experts, and alongside of it stand the unique land-grant colleges, which are without example elsewhere, and the 69 State and Federal experiment stations. These colleges and experiment stations have a total endowment of plant and equipment of $172,000,000 and an income of more than $35,000,000, with 10,271 teachers, a resident student body of 125,000, and a vast additional number receiving instructions at their homes. County agents, joint officers of the Department of Agriculture and of the colleges, are everywhere cooperating with the farmers and assisting them. The number of extension workers under the Smith-Lever Act and under the recent emergency legislation has grown to 5,500 men and women working regularly in the various communities and taking to the farmer the latest scientific and practical information. Alongside these great public agencies stand the very effective voluntary organizations among the farmers themselves which are more and more learning the best methods of cooperation and the best methods of putting to practical use the assistance derived from governmental sources. The banking legislation of the last two or three years has given the farmers access to the great lendable capital of the country, and it has become the duty both of the men in charge of the Federal Reserve Banking System and of the Farm Loan Banking System to see to it that the farmers obtain the credit, both short term and long term, to which they are entitled not only, but which it is imperatively necessary should be extended to them if the present tasks of the country are to be adequately performed. Both by direct purchase of nitrates and by the establishment of plants to produce nitrates, the Government is doing its utmost to assist in the problem of fertilization. The Department of Agriculture and other agencies are actively assisting the farmers to locate, safeguard, and secure at cost an adequate supply of sound seed."

"The farmers of this country are as efficient as any other farmers in the world. They do not produce more per acre than the farmers in Europe. It is not necessary that they should do so. It would perhaps be bad economy for them to attempt it. But they do produce by two to three or four times more per man, per unit of labor and capital, than the farmers of any European country. They are more alert and use more labor-saving devices than any other farmers in the world. And their response to the demands of the present emergency has been in every way remarkable. Last spring [1917] their planting exceeded by 12,000,000 acres the largest planting of any previous year, and the yields from the crops were record-breaking yields. In the fall of 1917 a wheat acreage of 42,170,000 was planted, which was 1,000,000 larger than for any preceding year, 3,000,000 greater than the next largest, and 7,000,000 greater than the preceding five-year average.

"But I ought to say to you that it is not only necessary that these achievements should be repeated, but that they should be exceeded. I know what this advice involves. It involves not only labor but sacrifice, the painstaking application of every bit of scientific knowledge and every tested practice that is available. It means the utmost economy, even to the point where the pinch comes. It means the kind of concentration and self-sacrifice which is involved in the field of battle itself, where the object always looms greater than the individual. And yet the Government will help and help in every way that it is possible."

Control of *The* Onion Thrips

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FARMERS' BULLETIN 1007

United States Department of Agriculture

THE ONION THRIPS, a minute, prolific insect almost invisible to the unaided eye, is the most serious menace to the onion-growing industry throughout the whole United States. The damage to the onion crop alone is estimated to be at least $2,250,000 annually and, including the injuries to other crops, the loss will approximate $3,000,000 or more.

The thrips preys upon cabbage, cauliflower, and similar plants, cucumber, melons, and other vine crops, and most other garden and truck crops, though it is more injurious to some than to others. It is injurious to roses and some other ornamentals and to greenhouse plants. It also breeds upon a large variety of weeds.

Clean farming and proper crop rotation help to control the pest. Spraying with nicotine sulphate solutions has proved the most effective treatment. This bulletin gives directions for this work, with illustrations showing the outfits most effective under differing conditions.

Contribution from the Bureau of Entomology
L. O. HOWARD, Chief
Washington, D. C. **January, 1919**

CONTROL OF THE ONION THRIPS[1]

F. H. CHITTENDEN,
Entomologist in Charge, Truck-Crop Insect Investigations.

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MANIFESTATION OF INJURY.

THE ONION THRIPS, incorrectly called "thrip" and "onion louse," is an insect of almost microscopic dimensions. It causes injury to the onion crop practically throughout the United States, producing a condition somewhat generally known in different sections as "white blast," "white blight," and "silver top." (See fig. 2.) It is also the cause of "scallions" and "thicknecks"—undeveloped and unmarketable bulbs. (See figs. 3 and 4.) In aggravated cases whole fields, and sometimes large areas comprising an entire onion-growing region, are rendered nonproductive and in extreme cases the crop is completely destroyed. The whitened appearance of the onion leaves and tops is due to the extraction of the plant juices, first by rasping and then by suction. In a short time after attack begins the leaves become characteristically whitened, then curled, crinkled, and even twisted, and finally die down permanently.

DESCRIPTION.

The onion thrips is microscopic in all of its stages. The general appearance of both sexes, which are very similar, is shown, highly magnified, in figure 1. The adult insect is at first pale yellow, but later turns brown, with the abdomen somewhat darker. The wings are still paler yellow, with dusky fringes and bristles. The length is only about one twenty-fifth of an inch.

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[1] *Thrips tabaci* Lindeman.

DISTRIBUTION.

The onion thrips was introduced from Europe and was first noticed in the United States in 1872. Its spread was very slow until the year 1907, when it appeared simultaneously all over the United States. It is widely distributed in North America, occurring wherever onions are grown, as also in other regions from the Atlantic to the Pacific and from Canada to Mexico. It also inhabits the West Indies and the Bermudas, where it attracted considerable attention before the 1907 outbreak mentioned.

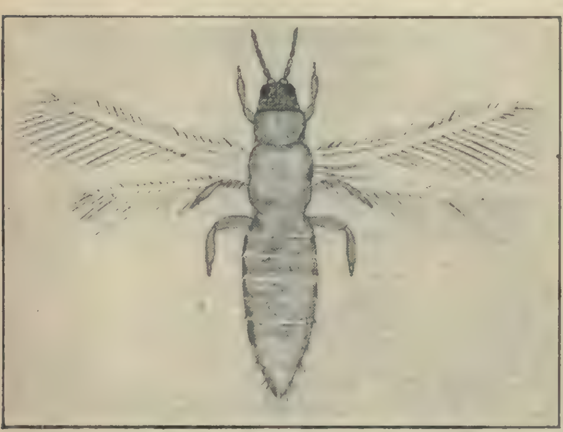

FIG. 1.—Adult of the onion thrips. Highly magnified.

During all of the past 11 years injury has been more or less noticeable in the States of Indiana, Texas, New York, New Jersey, Maryland, Virginia, Colorado, California, and in the District of Columbia, and to a somewhat less extent in Ohio, New Mexico, Tennessee, Mississippi, Connecticut, Idaho, Illinois, Michigan, Louisiana, Pennsylvania, Florida, North Carolina, Arkansas, Iowa, Washington, and Oregon. It has also attracted attention in Canada.

LIFE HISTORY AND HABITS.

CONDITIONS FAVORING INFESTATION.

The onion thrips appears in practically all cultivated fields in the United States, as well as in many uncultivated areas where suitable food plants for its sustenance are to be found, so that there is always danger of injury to onions and other susceptible crops, whether grown in new or old land.

Observations tend to demonstrate that in some localities at least the previous crop makes little difference as to infestation. Nevertheless, taking the country at large, there is always grave danger of infestation to onion fields where crop rotation is not practiced, and where onions follow onions, cabbage, cauliflower, or other plants favored by this pest, and where culls and other refuse from onion beds are allowed to accumulate in and near fields to be replanted to onions.

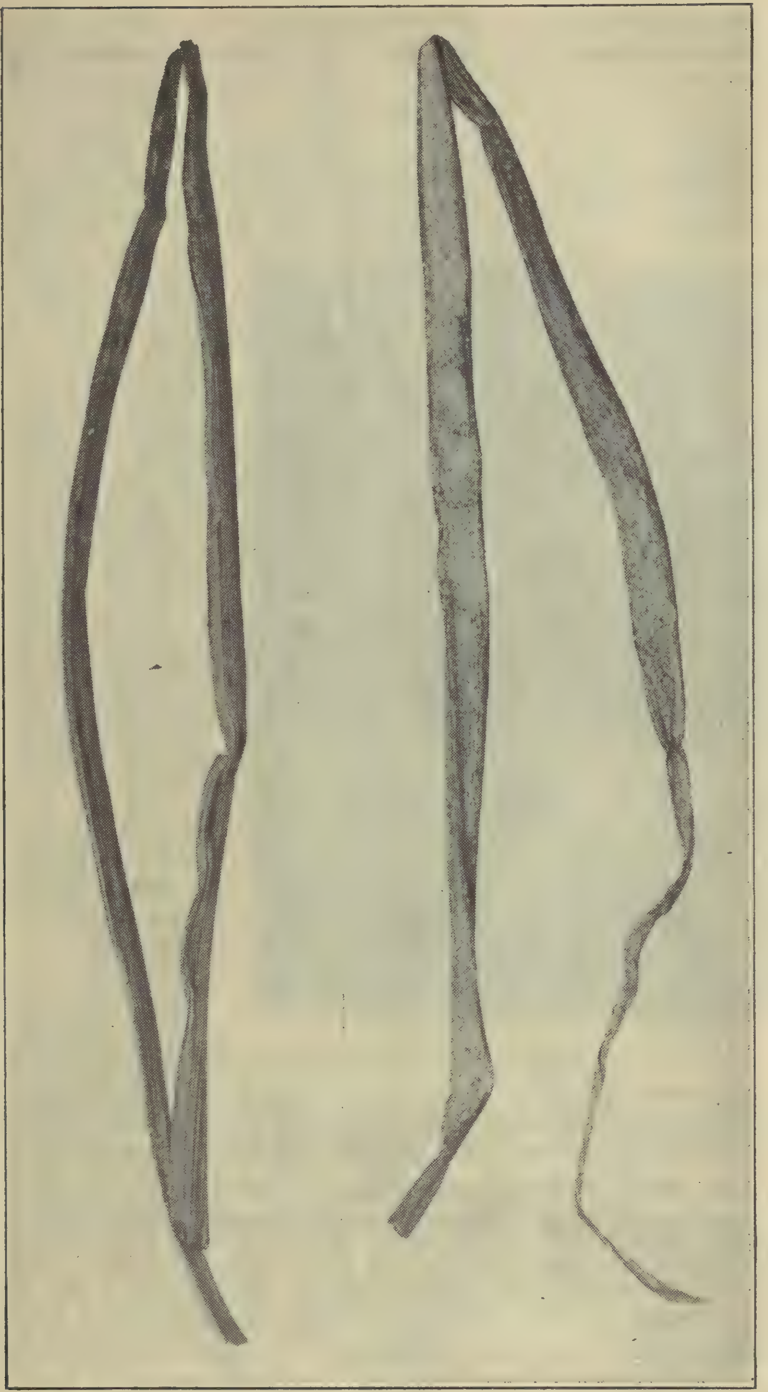

FIG. 2.—Onion leaf showing injury by onion thrips at right; uninjured leaf at left.

There is little evidence that the quality of the soil has in itself any particular bearing on the degree of infestation of the onion or other crop.

LIFE HISTORY.

The adult or parent thrips usually is found in the "bud" of the onion plant, not appearing on the leaves to any extent until present in great numbers. On other plants, such as weeds, the onion thrips are often found embedded in the flowers, and usually occur on the lower sides of the leaves.

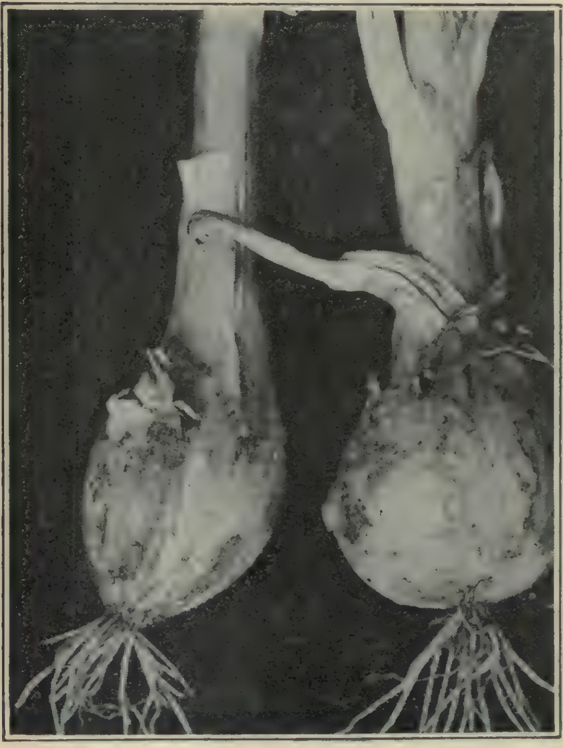

FIG. 3.—"Thickneck" onions, a deformation caused by the onion thrips.

The female, by means of a tiny sawlike organ with which she is provided near the end of the abdomen, cuts a slit, in a leaf or stem usually, and in this slit deposits an egg, generally inserting it under the outer layer, where it is concealed from view. Here the egg hatches in a few days and the young thrips works its way out and begins to feed.

The young thrips suck the juices of the plants in the same manner as do the adults, and since they feed continuously their growth is rapid. In one or two weeks, depending upon the temperature, they cease feeding and seek a suitable location in which to transform to the final stage of the nymph and from that stage to the adult.

The life cycle from the time of laying the eggs until the maturing of the adult has been found to require, under the most favorable conditions—i. e., in a warm temperature—about three weeks. Half a dozen generations might thus be produced during a season, at least in the semitropical portions of southern Texas, where this species abounds.

FOOD PLANTS.

Besides onions, garlic, and related plants, the onion thrips injuriously attacks cabbage, cauliflower, parsley, cucumber, melons, pumpkin, squash, kale, turnip, tomato, lettuce, beets, beans, peas, celery, blackberry, strawberry, and practically all vegetable and truck crops. This includes potato, sweet potato, and mustard, plants which are seldom severely injured. It is quite troublesome, however, on ornamental plants; indeed most serious injury is frequently caused to roses and carnations in greenhouses, the damage sometimes amounting to the destruction of entire plantings. Greenhouse cucumbers frequently suffer severe losses. The premature dropping of tomato blossoms is frequently attributed to this pest, although sometimes due to other causes, such as improper use of fertilizers and unfavorable temperature and moisture conditions.

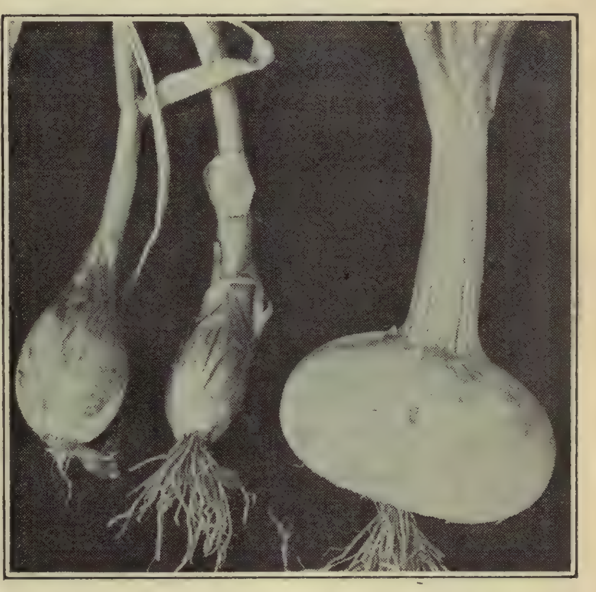

FIG. 4.—" Scallions," undeveloped onions due to the work of the onion thrips, at left; normal onion, for comparison, at right.

Among other crops tobacco has been reported injured by this thrips in Europe, but not in America, so far as we know, and there are records of injurious occurrences on cotton, timothy and other grasses, clover, rye, and wheat.

The onion thrips breeds freely on a great variety of weeds, a list of which would fill considerable space. Some of the commoner weeds affected include dandelion, daisies, mullein, catnip, goldenrod, ragweed, aster, smartweed, and wild grasses.

NATURAL CONTROL.

Rains, and especially heavy, driving storms, frequently destroy great numbers of thrips, a fact which has come under the notice of practically everyone who has studied this group of pests. Among other factors of natural control are beneficial ladybirds of several species, the spotted ladybird[1] (fig. 5) leading in this respect. The convergent ladybird[2] is also prominent as a thrips destroyer. About the second in importance is the so-called insidious flower-bug.[3] It is also destroyed by internal parasites and many other insect enemies are known.

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[1] *Megilla maculata* De Geer. [2] *Hippodamia convergens* Guér. [3] *Triphleps insidiosus* Say.

METHODS OF CONTROL.

The methods of treating onion fields affected by the onion thrips are somewhat complicated because we can not place reliance on any single method, but rather on a combination of several. Kerosene-soap emulsion and fish-oil soaps applied as sprays afford some relief, but tobacco and nicotine extracts are the best direct remedies.

Because of their minute size, which enables them to conceal themselves in the sheaths of onions and in similar locations, thrips are difficult to reach. They are more susceptible to insecticides in the younger stages; hence remedial measures should be undertaken early in the season to act as preventives rather than cures.

CLEAN METHODS OF FARMING.

Too great stress can not be laid on the value of clean methods of field management, since the onion thrips breeds on all but a few vegetables, on many ornamental plants, is a pest in greenhouses, and develops on weeds of various kinds. After the onion crop is gathered, unmarketable and other useless material—"scallions," culls, tops, "thicknecks," and injured and volunteer plants—should be promptly destroyed by burning or deep burial and not left where the insects are very apt to spread to neighboring plants or to reinfest onions or other susceptible crops when these are planted in rotation.

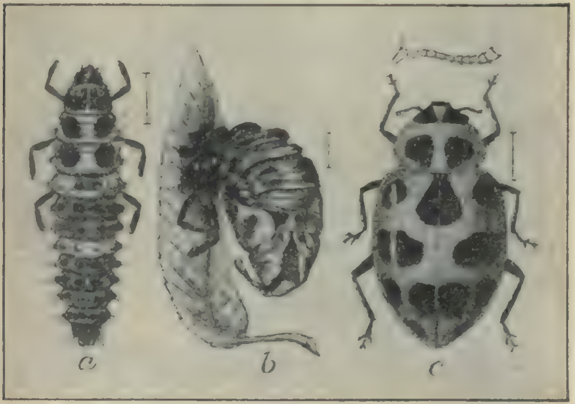


FIG. 5.- The spotted ladybird, a great enemy of the onion thrips: *a*, Larva; *b*, empty pupal skin; *c*, beetle with enlarged antenna above. All enlarged.

Crops like cabbage and cauliflower, cucumber, and like plants should not be grown contiguous to onion fields, since each serves as a breeding place for the onion thrips, and if the thrips first attacks the onions it will pass over to the cabbage fields adjoining. Such a combination provides, other things being equal, that the thrips will have abundant opportunity for wintering over to attack the early plants of the next year.

It is of the greatest importance that crop remnants of whatever nature should be removed from the soil before planting, as well as afterwards. In most cases this is accomplished by plowing and disking. The turnrows and margins of the fields should be cultivated often enough to prevent the growth of weeds, many forms of which harbor the onion thrips.

Clean culture should be observed as far as practicable throughout the season.

DANGER IN GROWING FROM SETS.

The practice of growing onions by starting them from "sets" is also an extremely common cause of early injury by the onion thrips. Considerable injury can be prevented by dipping the sets about a week before planting in nicotine sulphate at about the same strength as is used in spraying (p. 10) and then giving two dippings in the same insecticide at planting time.

Early planting is of service, especially northward.

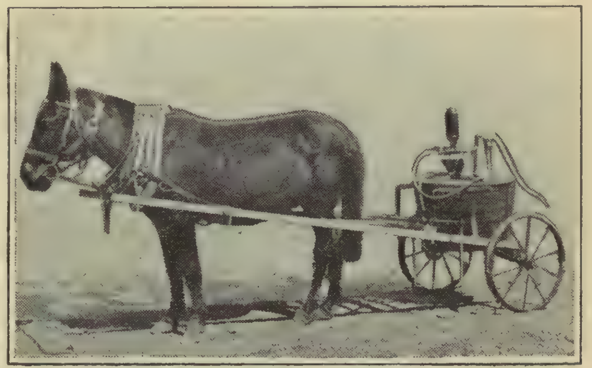


Fig. 6.—A light-weight spraying outfit suitable for spraying against the onion thrips in irrigated and bog lands. Used successfully at Rocky Ford, Colo.

CROP ROTATION.

With an insect capable of sustaining life on such a variety of vegetation, it is difficult to name an alternate crop plant that is not likely to be injured. For rotation cabbage, cauliflower, and other crops of that family, cucumber and related vine crops, and strawberry should be avoided; also ornamental plants, particularly roses and carnations, all of which are much favored by thrips. Conversely the plants mentioned should not be grown near, before, or after onions.

These plants should not even be grown in the vicinity of onion fields.

Certain other vegetables, however, such as potato, sweet potato, peas, beets, and spinach, although they may be attacked by the adult thrips, are not, as a general rule, materially damaged.

STIMULATING GROWTH.

Manure and other fertilizers should be used freely to stimulate early growth.

The onion thrips often injures the plants to such an extent that growth ceases and the plants do not again start growing even after most of the thrips have been killed by spraying. In such cases growth should be encouraged by irrigation, cultivation, or, better yet, by an application of a quick-acting nitrogenous fertilizer. Unless this is done the thrips may become so abundant again that cultural methods will be practically useless.

A vigorously growing plant always stands a good chance of "keeping ahead" of the thrips.

SPRAYING WITH NICOTINE SULPHATE.

Onion growers should be able to control the thrips with the aid of the instructions here presented, provided they employ the proper sprayers for the purpose. Experts of the Bureau of Entomology who have been working on the onion thrips for several years past have been most successful with nicotine-sulphate solutions.

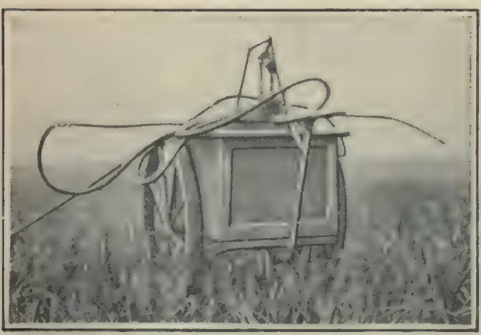


FIG. 7.—A three-wheeled sprayer supporting two nozzles, used with success in spraying onions for the thrips at Laredo, Tex.

Where nicotine sulphate is mentioned in the formula a solution containing 40 per cent nicotine is understood.

The following nicotine-spray formula has been found the best for the control of the onion thrips:

Nicotine sulphate (40 per cent)	⅜ pint.
Soap (dissolved)	4 (or more) pounds.
Water	50 gallons.

This formula gives 1 part nicotine sulphate to 1,000 parts water.

The quantity of soap required will vary with the quality of water, more soap being required in "hard" water; but on the average the proportion specified in the formula will give satisfaction. An examination of a freshly sprayed leaf will show whether there is sufficient soap in the mixture. If the spray draws together in drops, and leaves a part of the foliage dry, more soap should be added. Where possible, fish-oil soap should be used, but if it can not be procured, cheap laundry soaps will do. The composition of the cheap soaps is variable, and if too much soap is used, some injury may result to tender foliage, especially if applied in the hot sunshine.

In the use of nicotine sulphate the effective application of the spray is of the utmost importance, since it is primarily upon this that the success or failure of the treatment depends. If the liquid has stood for any length of time it should be agitated thoroughly before use. The insects themselves must receive a thorough coat of the spray or they will not be killed, and immediate inspection after spraying should show the foliage occupied by the insects to be completely wet.

Spraying should be done always on the first appearance of the insect, not only because it is good practice to keep the plants free from pests, but because more thorough work can be done on small plants.

When spraying is once begun it should be continued at frequent intervals, as often as from 7 to 10 days, if necessary, provided there is no heavy rainfall during this period, and no surrounding breeding host for the insect. The spraying should, as a general rule, be continued up to within three or four weeks of harvest time.

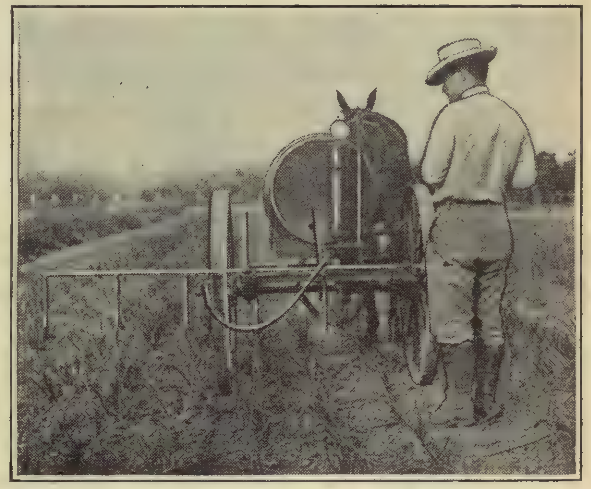


FIG. 8.—Traction sprayer at work in onion field. Note small space occupied by mule at right.

EFFECT OF NICOTINE SULPHATE ON THE PLANTS.

Plants sprayed with a nicotine sulphate combination present a striking contrast to those which are not so treated. In Maryland and in the District of Columbia, a single spraying of nicotine sulphate, conducted by Bureau of Entomology experts, gave similar results, the plants doing better and a larger percentage of thrips being killed than by the use of other insecticides.

THE USE OF SOAPS.

Kerosene-soap emulsion has sometimes proved a failure in alkali regions and elsewhere and is, moreover, difficult to make with hard or alkaline water.

The addition of soap, it should be remembered, is chiefly for action as a spreader, the nicotine acting better in this combination, as it tends to wet the bodies of the insects more completely than when used alone.

Soaps are also insecticidal and are powerful agents in the destruction of small soft-bodied sucking forms of insects, such as certain plant-lice.

DANGER OF BURNING PLANTS.

Spraying with soap alone has been tested against the onion thrips, but only the standardized sorts, such as fish-oil soap, may be used with safety, i. e., without danger of "burning," and this is more expensive than a nicotine-sulphate-soap spray when used at the proper strength. Moreover, the latter is more easily prepared. Nicotine sulphate may be obtained of most seedsmen, but fish-oil soap is not sold in all localities.

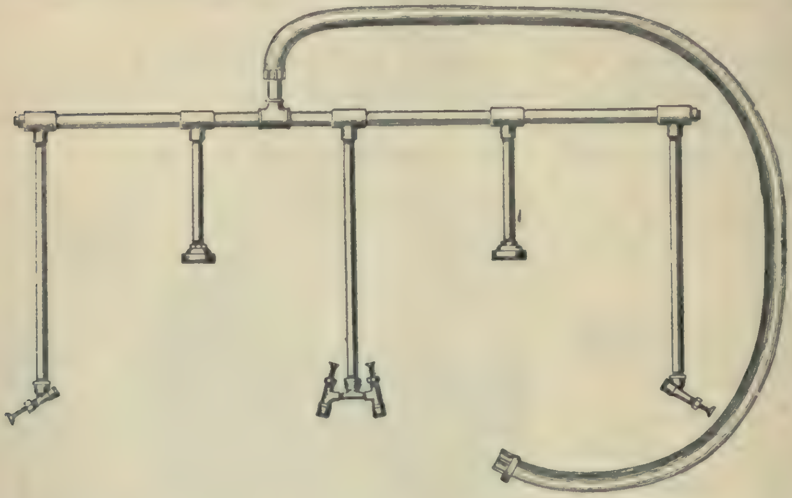


FIG. 9.—Two-row arrangement of nozzles, ready for spraying onion thrips. Nozzles in center are shown so turned as to illustrate cluster attachment. They should be directed outward and upward in use, as shown at sides, one to each row.

Complaints are frequent that injury results, even where the nicotine-soap spray is employed and the soap is used in any large quantity. There are two reasons for this: (1) In midsummer the temperature is sometimes so high in the sun that some burning may result, and (2) when the plants are badly injured by thrips, so much of the epidermis or outer skin is removed that only a neutral or mild soap can be used with absolute safety.

SPRAYING MACHINERY AND EQUIPMENT.

The question of the best spraying-machine nozzles and other apparatus for use in spraying onion fields against the onion thrips is most important. It is governed largely by local conditions and, because of the possibility of injuring the crop through the usual system of planting and type of growth, is limited in application. Apparatus suitable for the requirements in irrigated lands in southern Texas may be unsuitable for work in the bog lands of Indiana and Michigan. In Colorado, the light one-horse sprayer, illustrated in figure 6, was found to be quite efficient against the onion thrips. In that region the fields are considerably smaller than in southern Texas, and the character of the soil and method of providing irrigation ditches afford better opportunity for the use of a traction type. The sprayer shown in figure 7 was successful in southern Texas, especially after the application of a boom for the purpose of holding the hose above the tops of the plants.

In spraying for thrips, the nozzles should be held well down over the plants, and the spray applied with as much force as possible, since, as has been emphasized, it is necessary to bring the solution into contact with the insects themselves, and through their habit of concealment in the leaf sheaths and the young growth of the plant they are reached with difficulty. The power is applied by a gasoline engine so that a pressure of 150 pounds or more, with consequent thorough application, is readily secured. Where onion fields may be so planted as to allow at intervals a distance of 18 to 20 inches between rows it is possible to employ a lightweight traction sprayer such as is shown in figure 8. For drawing such a type of machine a mule is preferable to a horse, since the smaller feet are much less likely to injure the crop. Figures 9 and 10 illustrate a typical nozzle arrangement for spraying either two or four rows with a sprayer of this type. The upturned nozzles at the sides produce, in conjunction with the larger disk-type nozzle operating from above, a thoroughly effective mist-like spray.

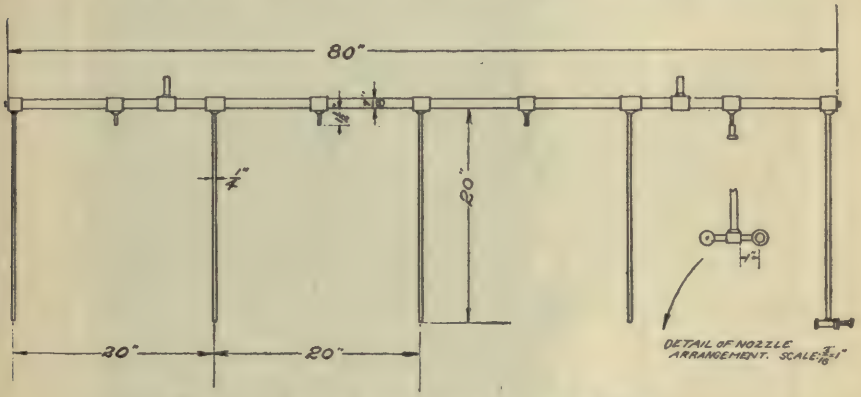


FIG. 10.—Four-row attachment for onion sprayer.

For use in the muck lands frequently employed in the North for onion growing, a different apparatus has been more satisfactory. There the soil is so soft and spongy that serious damage frequently results to one or more rows of onions through the use of traction apparatus. A type of power sprayer which has been effectively and economically used on lands of this character in Indiana and Michigan is shown in figure 11. This sprayer derives its power from a gasoline engine and supplies, through two pipe booms, nozzle clusters provided with 3 to 4 disk-type nozzles. The boom section of pipe, which is attached to the sprayer tank and supported by guy wires,

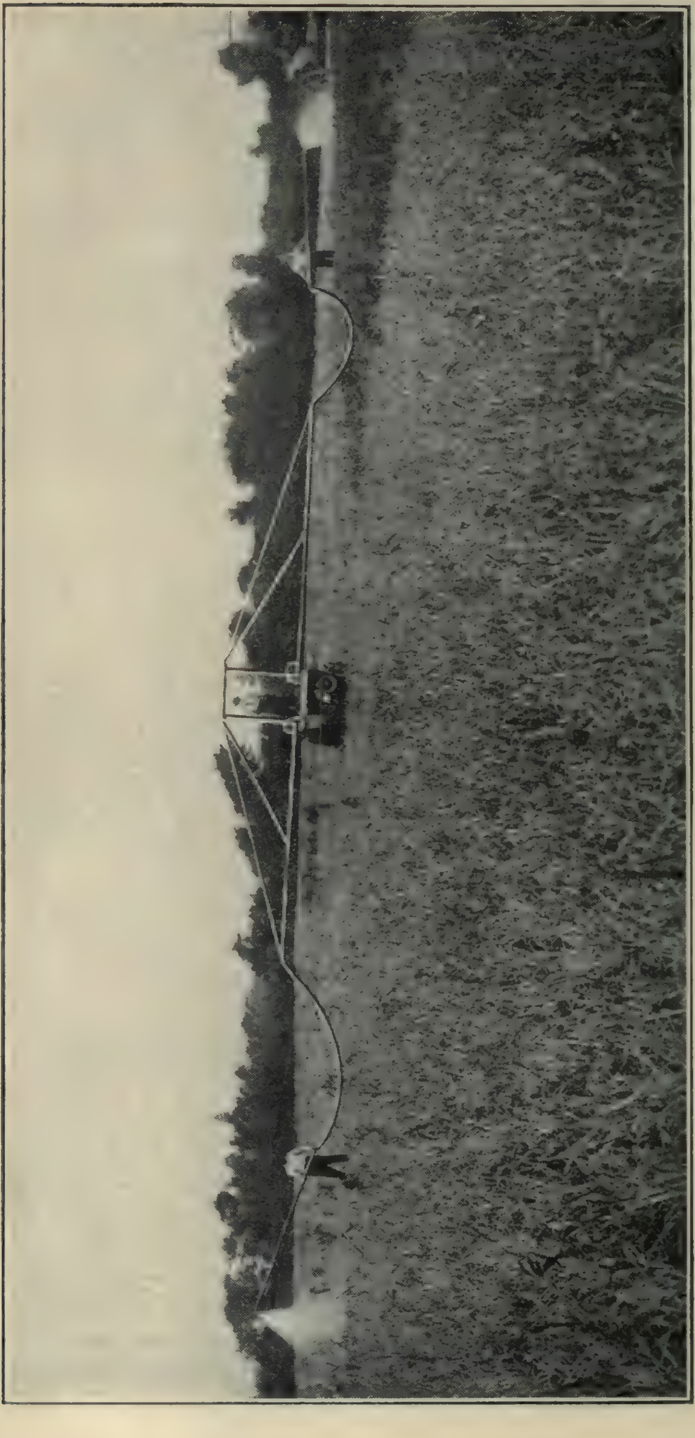


FIG. 11.—Power sprayer in operation in onion field. This type of outfit is for treatment of a strip 80 feet wide.

will swing through an angle of 180° by means of a pivot union attached at the standard. It should be placed at such a height as to clear a man's head without difficulty, that it may not hinder the operator, and should not be too long, since it may become twisted out of shape by strain. About 20 feet should be sufficient. The hose connection from the end of this boom, from 10 to 15 feet in length, attached to a 10-foot spray rod, will afford a spraying radius of 40 feet on each side of the tank. With this type of outfit a strip 90 to 100 feet in width can be treated without injury to more than one or two rows of onions in the center.

The various types of sprayers, nozzles, and other apparatus, discussed and illustrated in this bulletin, are for sale by manufacturers of agricultural implements, whose advertisements appear in the standard agricultural journals. The entomologists of the State agricultural experiment stations and the State entomologists will furnish information in regard to spraying apparatus, as will also county agents and farm advisers.

The information which has been given in regard to the treatment of onion and other fields infested by the onion thrips is based on the work of experts who have had a very extensive practical experience with the onion thrips, notably Mr. M. M. High and Mr. J. E. Graf. The following advice given under the heading "Hints to the onion grower" is adapted from information furnished by Mr. High founded on his personal experience with the onion thrips during several years' activities in the principal onion-growing regions of Texas and Indiana.

If the onion grower hopes to produce a good crop in seasons when the thrips are abundant he will do well to follow carefully the hints on page 16.

HINTS TO THE ONION GROWER.

1. Begin spraying onions as soon as the adult thrips can be seen in any numbers or the characteristic whitening of the leaves is in evidence. Do not wait until there are hundreds of young thrips and the crop is injured.

2. Spray thoroughly with nozzles which produce a fine spray, and hold them as near the plants as possible and at the same time cover infested portions.

3. Employ sprayers that will stand at least 100 pounds pressure. If the system of planting will not permit the use of power sprayers, use good hand sprayers and keep them constantly pumped up, since thrips are not killed unless the solution strikes them with some force.

4. Do not plant early cabbage or cauliflower next to onion fields if it can possibly be avoided, since it may cost you dearly with your onion crop.

5. After onion, cabbage, and related crops are harvested, clean up the field and keep it clean, because thrips continue to breed on any living portion of these plants and on almost any kind of weeds that remain in the field.

6. After harvest, plow as deeply as possible and harrow and repeat before planting the following season if onions are to be planted anywhere in the vicinity.

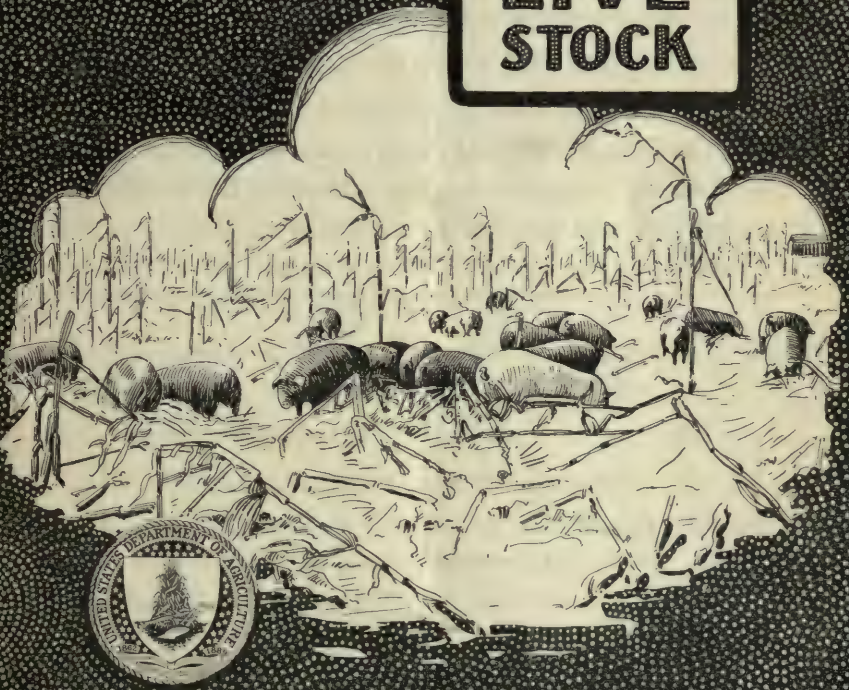
7. Plant as early as possible and use quick-acting fertilizers where possible after the onions are well set or the bulbs have begun to form, particularly so where the fertilizer has not been applied before planting.

8. Watch your onion fields constantly and keep the plants growing thriftily, since once the plants become checked in their growth from any cause the thrips will multiply with unusual rapidity and it will be a hard fight to save the crop.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1919

FARMERS' BULLETIN 1008
UNITED STATES DEPARTMENT OF AGRICULTURE

SAVING FARM LABOR by HARVESTING CROPS WITH LIVE STOCK



FARM LABOR often may be saved by using live stock to harvest and market part of the crops. By pasturing forage crops, and feeding down grain crops, much labor can be saved.

Hay must be secured for winter feeding, and grain for home use and seed, but on many farms a considerable acreage may be turned directly into beef, pork and mutton.

Pasturing off the crops also helps to maintain the fertility of the soil without extra labor or expense.

The keeping of farm animals furnishes profitable work during the winter when other work is less pressing, and when they require most care. This distributes remunerative labor throughout the year more evenly than otherwise would be possible.

This bulletin points out, largely by pictures of actual farm practices, some of the advantages of keeping live stock and of using the hogs, sheep and beef cattle to help harvest and market farm crops.

OFFICE OF THE SECRETARY
Contribution from the Office of Farm Management
E. H. THOMSON, Acting Chief
Washington, D. C. September, 1918

SAVING FARM LABOR BY HARVESTING CROPS WITH LIVE STOCK

J. A. DRAKE, Agriculturist

FARM ANIMALS AS HARVEST HANDS

LIVE STOCK, properly managed, will help the overworked farmer to harvest some of his crops profitably, thus saving man labor during the busy seasons. In return, the care of the young stock furnishes profitable employment for the farmer and his hired help, if he has any, during the winter and early spring, when work is slack. This not only saves much man labor during the busy season, but equalizes the labor throughout the different seasons.

When sufficient farm labor is not available to harvest all the crops, live stock offer a profitable method of taking care of the surplus hay and grain by pasturing them. The farm animals not only harvest them cheaply, but while doing so make profitable gains and help to maintain soil fertility. Instead of cutting the entire alfalfa, clover or other hay crop, pasturing some of it saves much labor.

The cash returns from the hay harvested by the live stock are usually fully equal to those received when the hay is harvested by hand labor.

Waste or poor rye, wheat, oats and barley may be hogged down to excellent advantage. Corn and mature soy beans are harvested successfully by hogs and sheep, and to some extent by cattle. It is usually customary to fence off part of a corn field by a movable fence, and after one strip is cleaned up, to inclose another. Plenty of water and a little salt are necessary for the greatest improvement of the live stock. Soy beans planted with the corn, and rape sown at the last cultivation, add to the feeding value of the corn.

PROSPECTIVE HARVEST HANDS

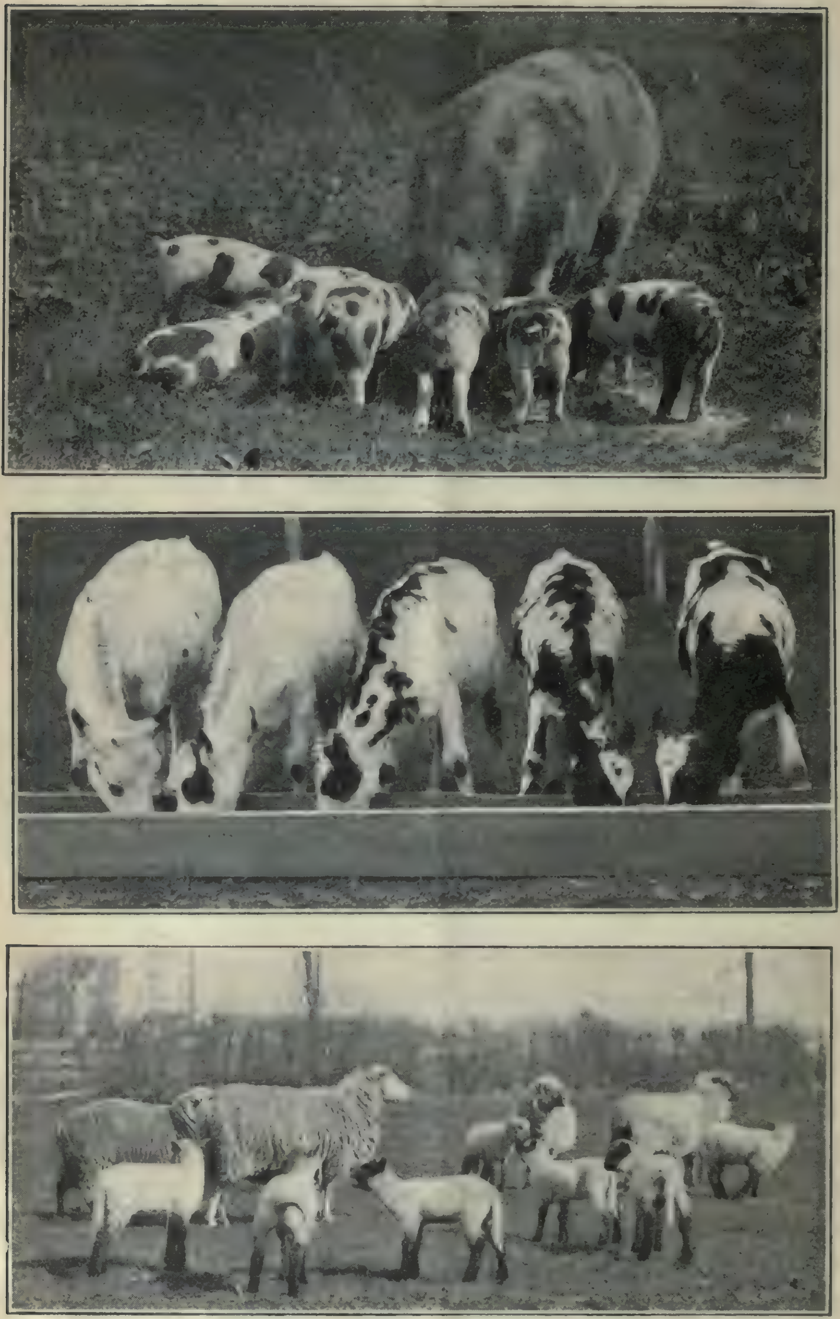


FIG. 1.—Young stock require considerable care and attention, but usually at a season when the farmer has little else to do. The farmer can well afford extra work with them in the winter, as these same animals will assist in harvesting his crops later in the season.

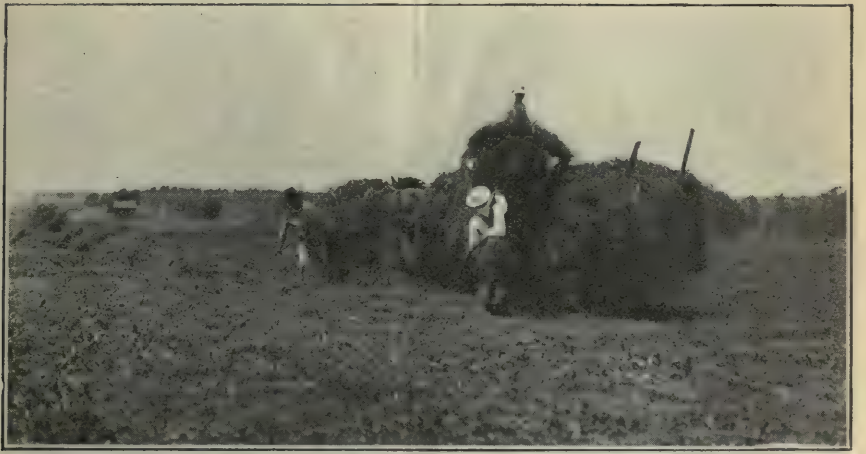


FIG. 2.—The greater part of the alfalfa hay crop must be harvested at a very busy season. Some advantage may be gained by the use of improved methods of haying, but at best much heavy work must be done.

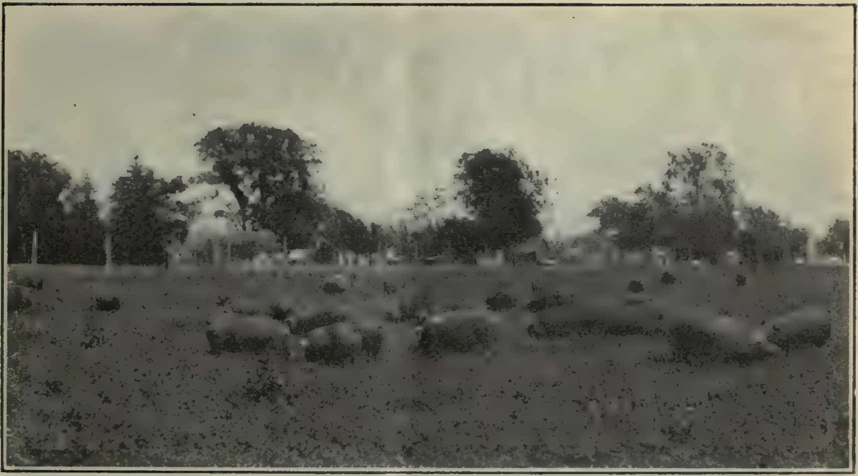


FIG. 3.—Much of the labor expended in harvesting alfalfa, as shown in figure 2, can be avoided by pasturing part of the crop with hogs. The hogs shown in figure 3 received three ears of corn each per day. With this light feeding of grain they consumed large quantities of alfalfa, and after the first cutting did the work of harvesting the entire crop.

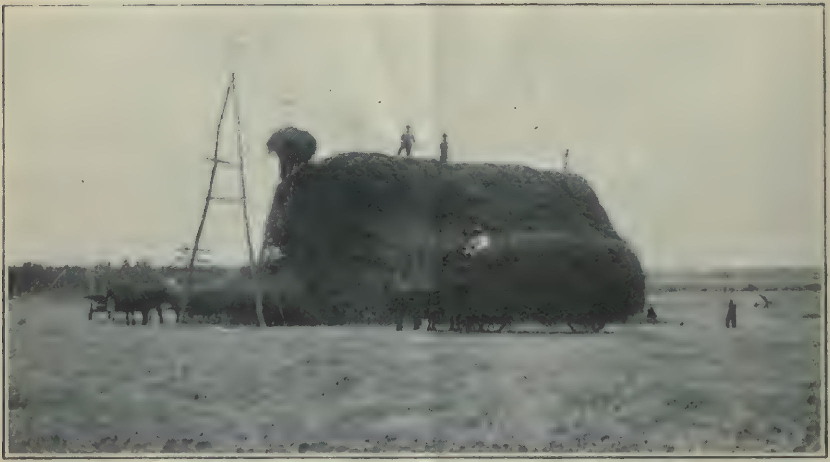


FIG. 4.—Putting up hay requires a great amount of labor, even where the best equipment is used.

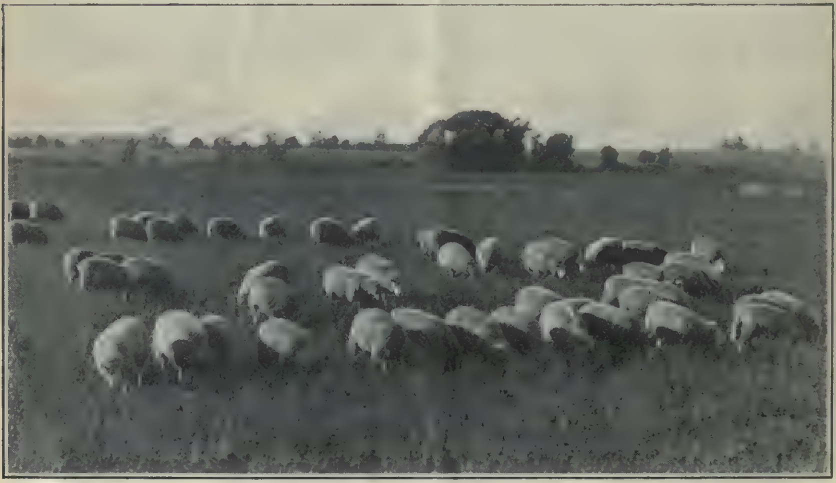


FIG. 5.—Grass crops can be utilized to advantage by pasturing with sheep. Much less labor is required than when the crop is cut for hay, as shown in figure 4.

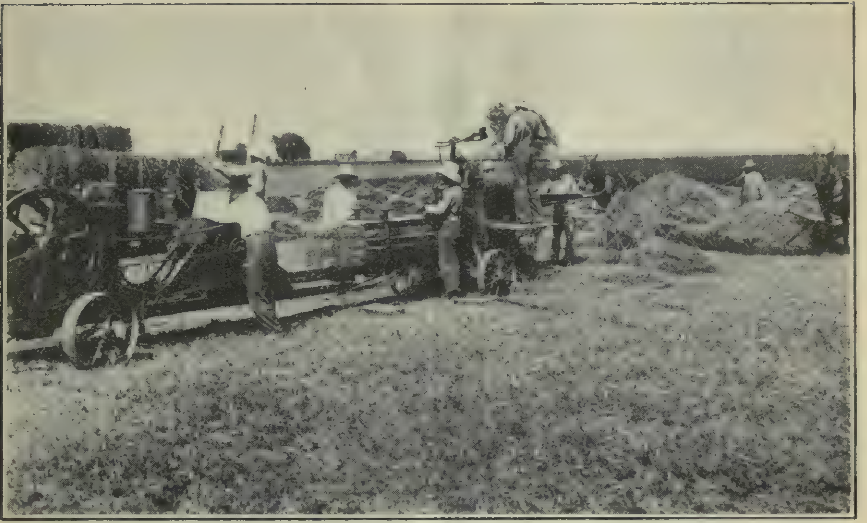


FIG. 6.—In commercial hay production, baling and hauling require much labor which is avoided when the crop is harvested by pasturing, as in figure 7.

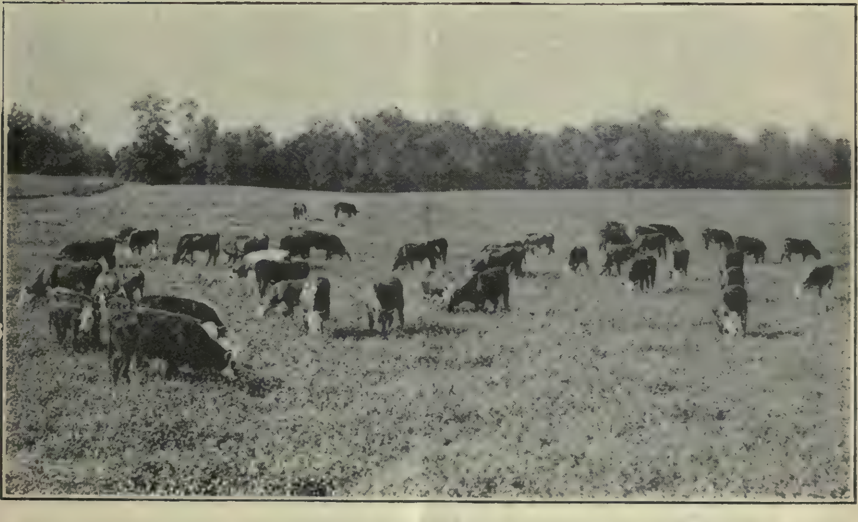


FIG. 7.—Beef steers consume large amounts of clover or alfalfa pasture and harvest the hay crop rapidly, generally with a good profit. With this method the labor required is almost negligible. Dairy cows and young stock are also very effective in pasturing clover and alfalfa. Usually some care is required at first to prevent bloating.

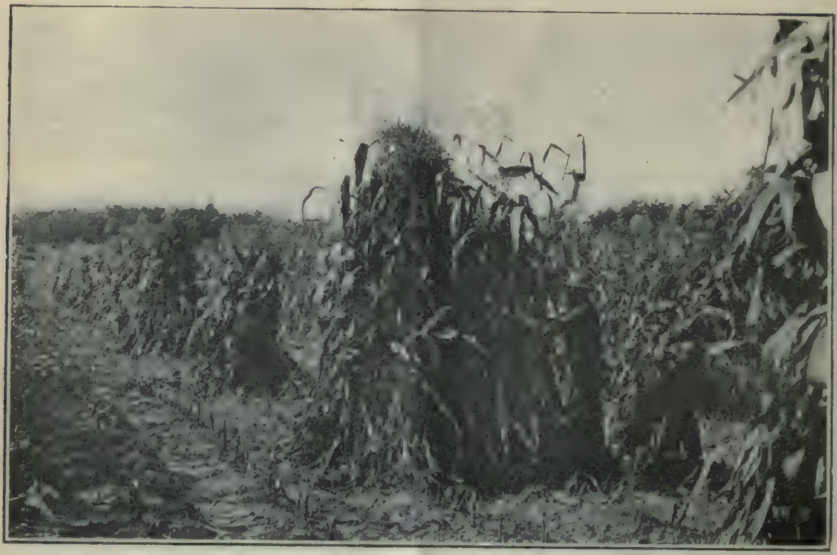


FIG. 8.—When corn is cut, husked and cribbed by hand, and later fed to live stock or sold on the market, much labor is required. Under present conditions it is difficult to get enough men to cut and husk large acreages of corn at a reasonable cost.

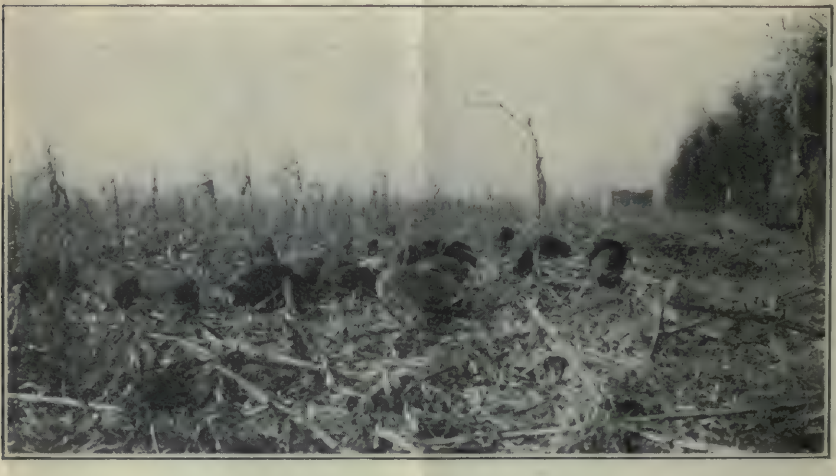


FIG. 9.—A most excellent way of harvesting a large part of the corn crop is to "hog it down." The hogs do the work with even less waste than if the corn is harvested by hand, as in figure 8. Furthermore, they make better gains than when fed. Thus there is a double advantage. The hogs shown above are a part of a herd that harvested an 80-acre field of heavy corn. The labor saved was a big item. These hogs had access at all times to tankage in self-feeders and made most excellent gains. Some farmers sow soy beans in the corn to take the place of tankage.

SHEEPING OFF CORN

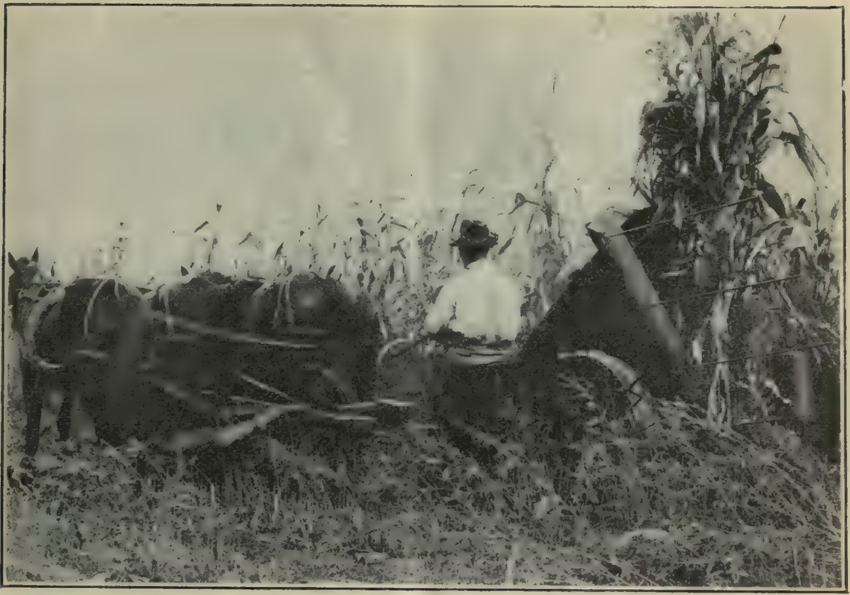


FIG. 10.—Harvesting corn with a corn binder speeds up the process somewhat, but requires nearly as much labor as harvesting by hand and effects little or no saving in expense.

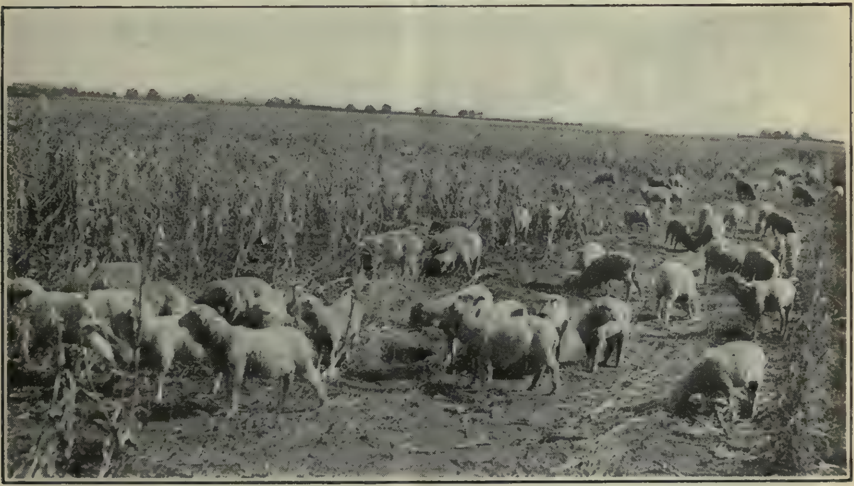


FIG. 11.—"Sheeping off" corn has become a rather common practice in some sections, affording another means of saving labor with the corn crop and returning the fertilizer value to the fields immediately. Usually soy beans or rape are sown in the corn at the last cultivation, which increases the forage. The sheep shown above have cleaned up the soy beans and are now beginning on the corn. They were left in until the entire crop was harvested, when they were fat and ready for market. It is usually a good plan afterwards to turn in hogs to clean up whatever waste may remain.

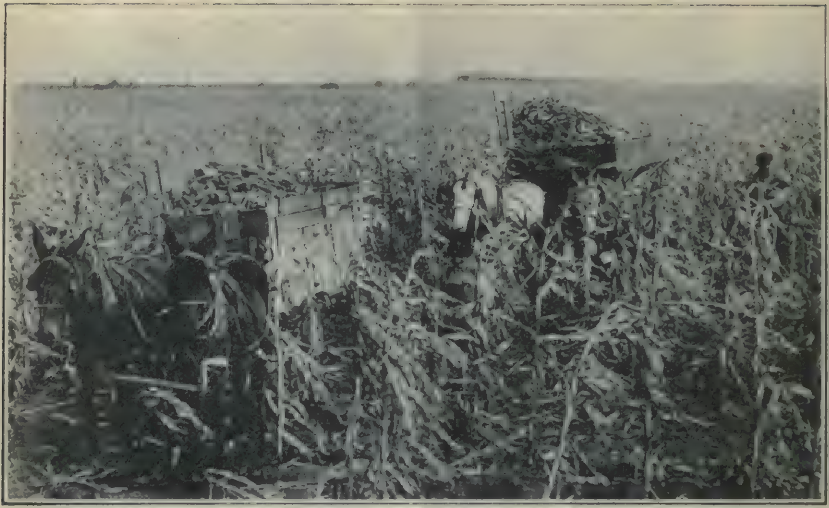


FIG. 12.—Husking corn from the standing stalks requires less labor than where the corn is cut, shocked and husked; but huskers are difficult to get, and even this method requires much more labor than where the crop is husked by live stock, as in figure 13. At the same time practically the entire value of the stalks and leaves is lost.

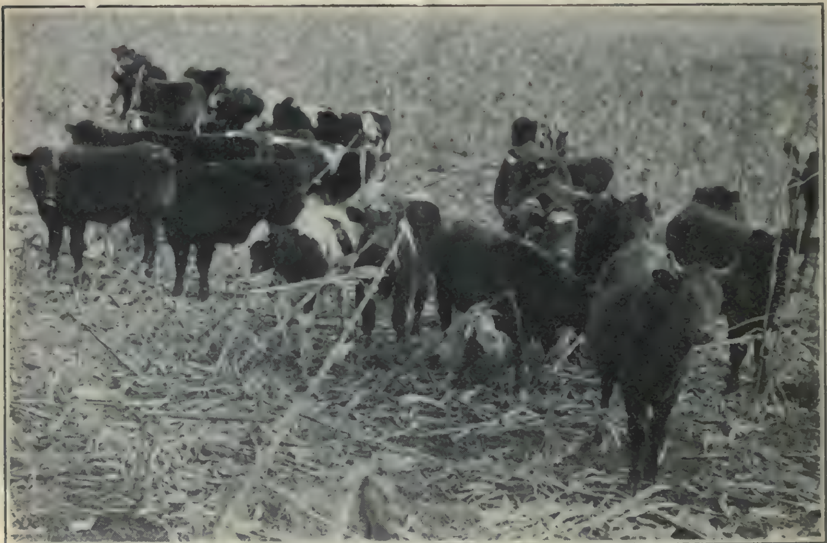


FIG. 13.—The use of cattle for harvesting corn succeeds very well if hogs are later turned in to clean up what the cattle may have left on the ground. Cattle may be used thus almost as successfully as sheep or hogs. Cattle are also sometimes used to consume the standing fodder after the corn has been husked from the stalks by hand, as in figure 12.

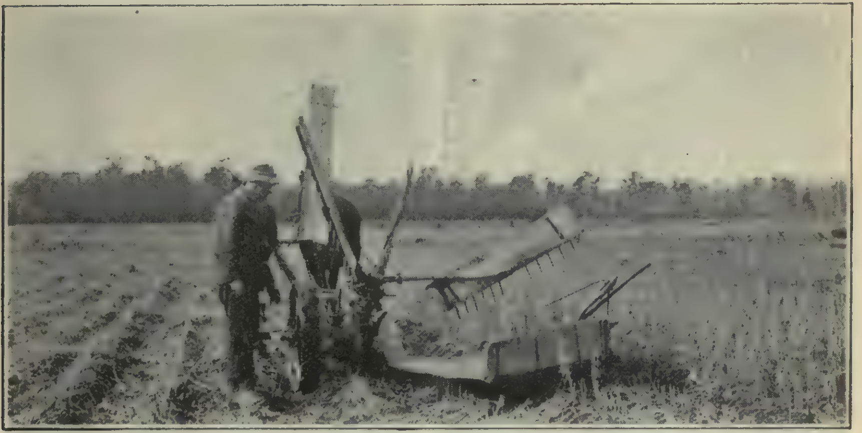


FIG. 14.—Soy beans for seed are cut with the self-rake reaper, grain binder, or mower, and in some instances with a bean puller. After cutting there is still considerable work to be done.

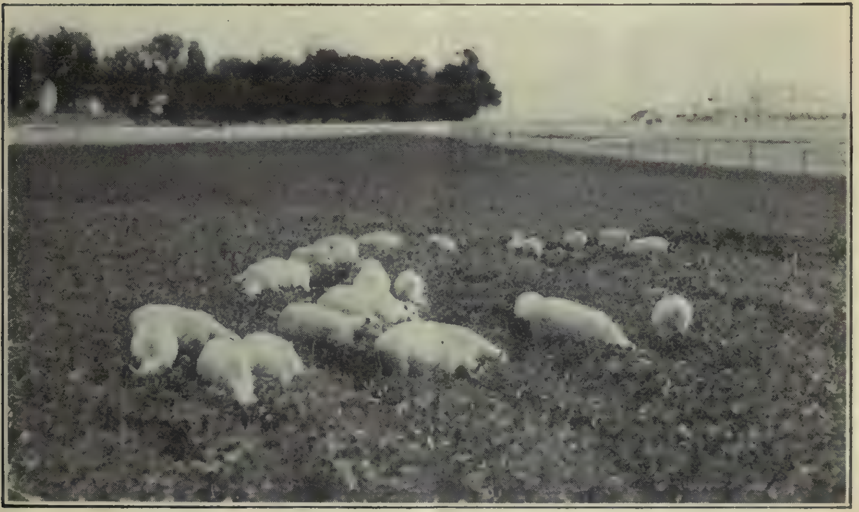


FIG. 15.—Soy beans furnish excellent grazing for lambs, and afford abundant forage free from the parasites common to permanent pastures This crop also is equally desirable for hogs and may be harvested by these animals both as forage and after the beans have ripened. Live stock thus save the labor of cutting (as shown in figure 14), shocking and hauling.

SOY BEANS—FEEDING VS. THRASHING

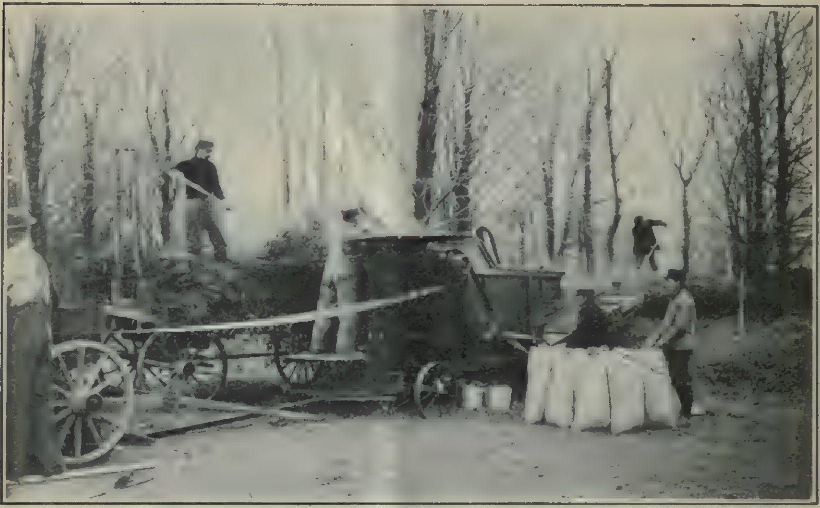


FIG. 16.—As a usual thing it is difficult to get a satisfactory outfit for thrashing soy beans. Here a special machine is being used, but the ordinary separator is generally the only machine available. Special attachments are necessary and few thrashermen care to go to the trouble to accommodate farmers with small acreages of beans. Large growers generally own their own equipment.

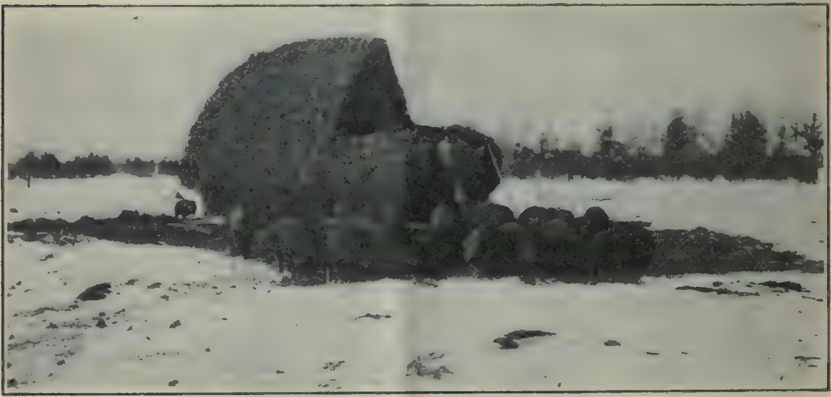


FIG. 17.—The labor and annoyance of thrashing soy beans, as in figure 16, may be saved by feeding the soy-bean hay to hogs in the winter. The beans supply the protein and save the purchase of tankage. The oil in the beans and the leaves of the plants which the hogs eat keep them in good condition. Soy-bean hay and corn make an ideal winter feed.

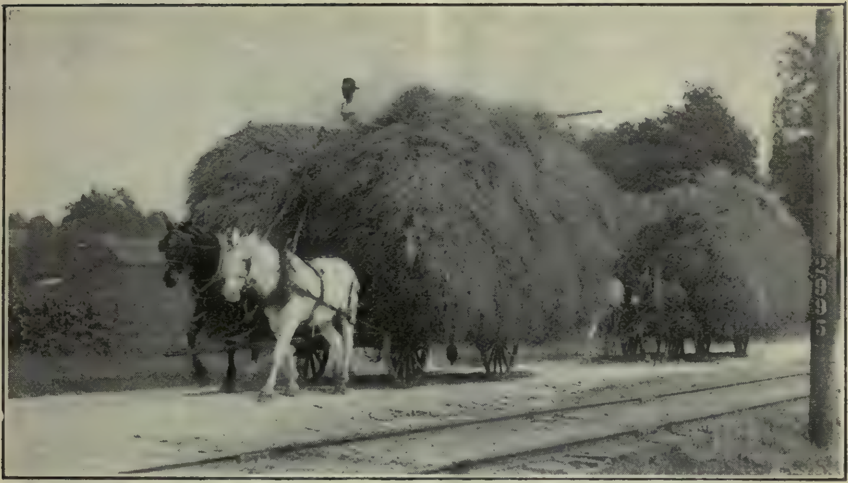


FIG. 18.—In the marketing of hay and roughage there is a large bulk to handle and haul to the point of delivery. Here there is much extra labor for the men and teams on grain and crop farms, and much fertility is taken off which might otherwise be returned to the fields.

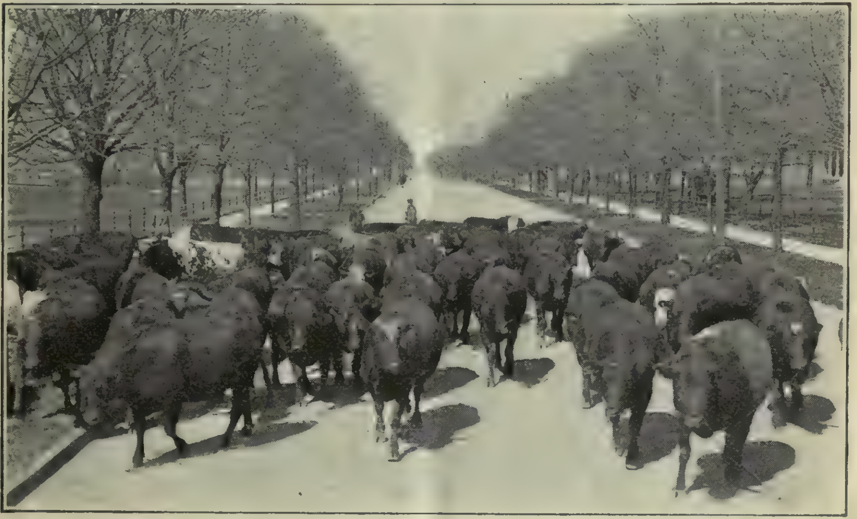


FIG. 19.—One of the chief advantages in keeping cattle is that they assimilate large quantities of roughage and waste feeds and carry it to market themselves in a more concentrated form. The farmer is thus saved the labor of marketing bulky feed products, as in figure 18, and the fertility remains on the farm.

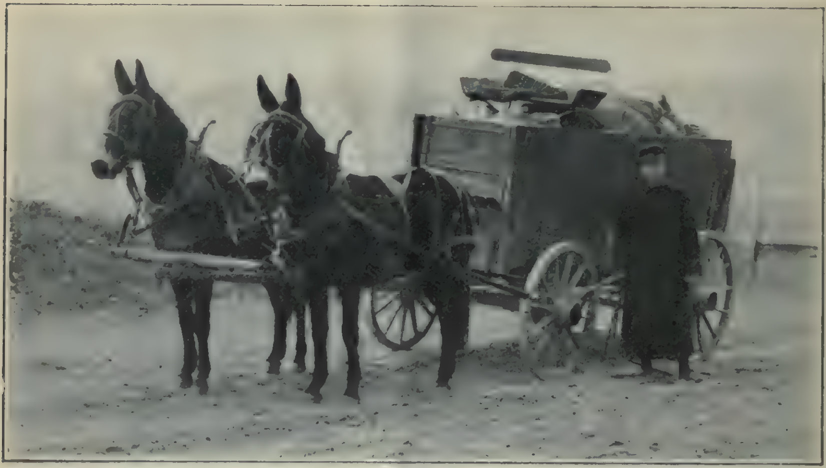


FIG. 20.—This team and wagon are transporting to market 50 to 60 bushels of corn per load. The same team and wagon with a good rack will haul to market from 225 to 250 bushels of corn in the form of finished hogs like those shown in figure 21.

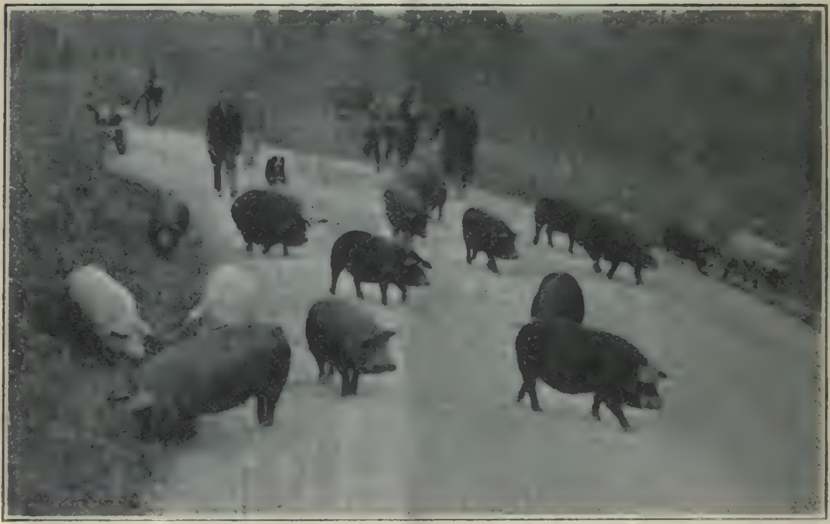


FIG. 21.—When only a short distance from market, live stock may be driven without any appreciable loss in weight. In this instance, in addition to a large amount of forage and pasture, these animals are carrying to market about the equivalent of one wagon load of corn, such as is shown in figure 20, to every four hogs.

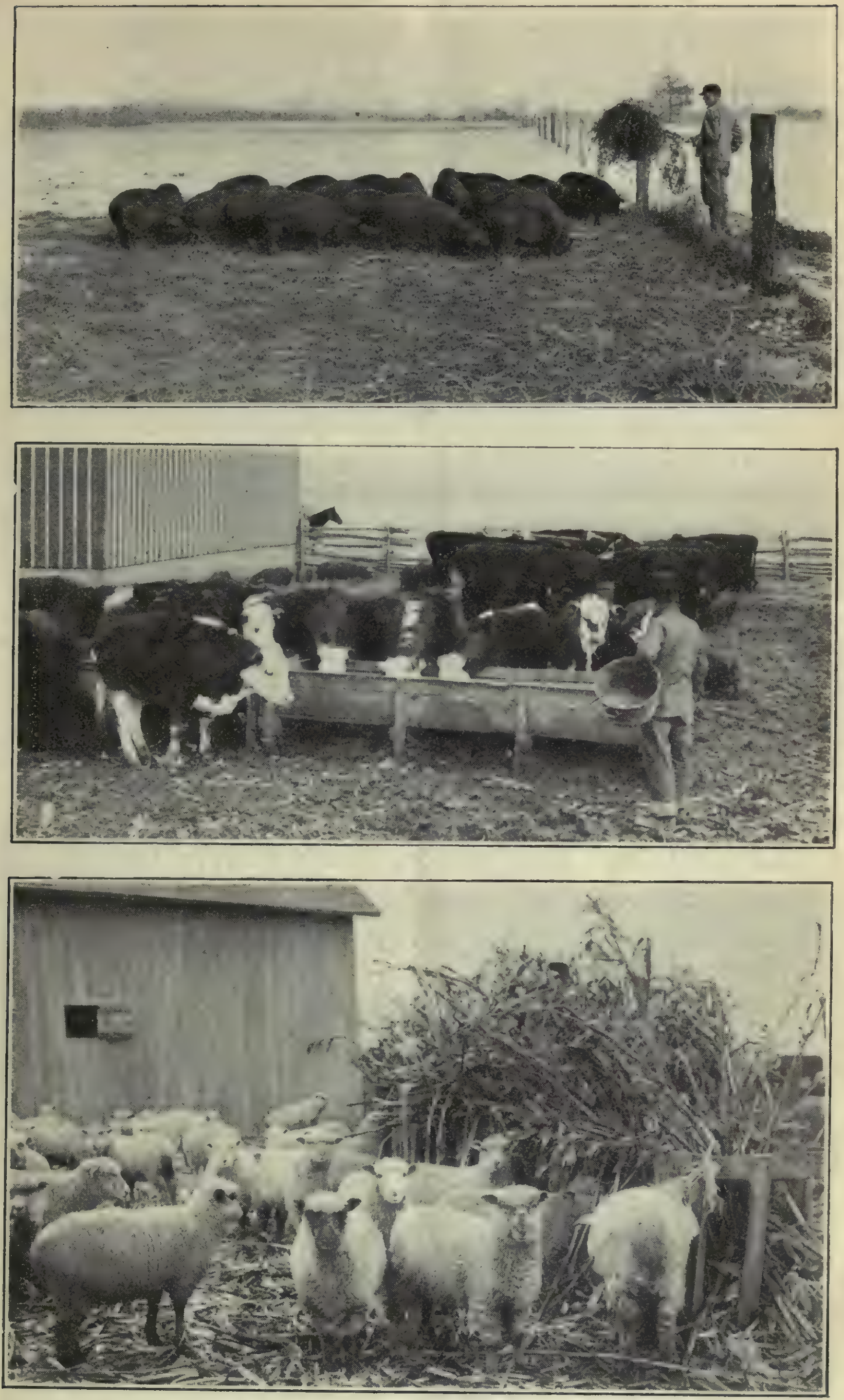


FIG. 22.—In many localities, especially in the North, feeding and caring for live stock furnishes about the only profitable winter labor that can be done on the ordinary farm.

THE FARMERS OF THIS COUNTRY are as efficient as any other farmers in the world. They do not produce more per acre than the farmers in Europe. It is not necessary that they should do so. It would perhaps be bad economy for them to attempt it. But they do produce by two to three or four times more per man, per unit of labor and capital, than the farmers of any European country. They are more alert and use more labor-saving devices than any other farmers in the world. And their response to the demands of the present emergency has been in every way remarkable. Last spring their planting exceeded by 12,000,000 acres the largest planting of any previous year, and the yields from the crops were record-breaking yields. In the fall of 1917 a wheat acreage of 42,170,000 was planted, which was 1,000,000 larger than for any preceding year, 3,000,000 greater than the next largest, and 7,000,000 greater than the preceding five-year average.

But I ought to say to you that it is not only necessary that these achievements should be repeated, but that they should be exceeded. I know what this advice involves. It involves not only labor, but sacrifice; the painstaking application of every bit of scientific knowledge and every tested practice that is available. It means the utmost economy, even to the point where the pinch comes. It means the kind of concentration and self-sacrifice which is involved in the field of battle itself, where the object always looms greater than the individual. And yet the Government will help, and help in every way that is possible.—From President Wilson's Message to the Farmers' Conference at Urbana, Ill., January 31, 1918.

FARMERS' BULLETIN 1009
UNITED STATES DEPARTMENT OF AGRICULTURE

HAY STACKERS

HOW THEY MAY BE USED IN THE EAST AND SOUTH TO SAVE LABOR

THE HAY STACKER is to stacking what the horse-fork is to putting hay in the barn, a saver of man labor.

It enables the farmer to lift the hay on to the stack by horse power instead of man power.

The stacker is used almost universally in the West, where stacking is the usual method of storing hay.

In the East and South, where much of the hay grown is stored under cover, the stacker could be used to advantage when it becomes necessary to stack, especially where labor is scarce.

Where the stacker is used, a boy or woman, driving the team that hoists the hay, can take the place of a man in the haying operation.

Stackers are comparatively inexpensive; there are several serviceable types which may be cheaply made at home.

Office of the Secretary
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E. H. THOMSON, Acting Chief
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HAY STACKERS.

H. B. McClure, *Agriculturist.*

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POSSIBILITIES OF HAY STACKERS IN THE EAST AND SOUTH.

HAY STACKERS can be used to advantage on many farms east of the Mississippi River as well as west. They are especially useful at times when farm labor is scarce, as they enable the farmer to handle hay more rapidly than by other methods, and in many instances a smaller number of men will be required. When the hay is loaded on the wagon by hand, and unloaded with a stacker, one-half of the hand labor is eliminated. If push rakes or hay loaders are used in connection with the stacker, pitching by hand is entirely avoided.

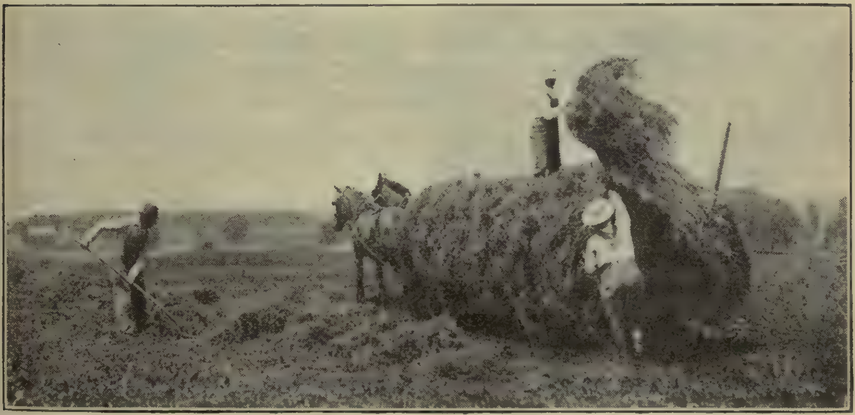

Fig. 1.—Loading the wagon by hand. Less hay is handled per man per day than by any other method. This method necessitates the use of men only, while other and better methods allow boys to replace men for some of the operations.

WHY STACKERS ARE NOT IN GENERAL USE IN THE EAST.

Many Eastern farmers are cautious about spending money for something entirely untried. A few have tried stackers but have abandoned them, owing partly to inexperience and partly to difficulty in getting their men to give them a fair trial. Some of the stackers purchased were cheaply constructed and of a type not suited to conditions. Other farmers have not attempted to use stackers because they have been in the habit of making small stacks containing from 1½ to 3 tons, and think that hay will not keep in a large stack such as is made with a stacker—an objection not based on facts.

Putting hay into the barn is preferable to stacking. When hay is stacked for any considerable time more or less loss occurs through exposure to sun and rain unless the stack is covered. In many sections hay barns would soon pay for themselves. Yet many farmers will continue to stack part or all of their hay until they become convinced that hay barns or sheds are a good investment. This bulletin, therefore, describes the different types of stackers in use, states the conditions favorable for each type, and points out the saving of man labor made possible by the use of the stacker.

DESCRIPTIONS OF HAY STACKERS.

Hay stackers in use may be divided into two general types according to the way they handle the hay. One type has teeth on which it receives hay brought to it by push rakes, and the other handles the hay by means of the harpoon fork, grapple fork, or sling.

The first type is represented chiefly by the "overshot" and the "swing-around" stacker. Each of these has long wooden teeth, like those of a push rake. The push rake drops its load of hay directly on these teeth. When the push rake is operated properly, there is no necessity for hand work, except that occasionally it may be necessary to gather up scattered hay with a fork when several push rakes are used. Two horses are used to elevate the hay to the proper height to be dropped on the stack.

The second type, stackers that do not receive hay directly from push rakes, but handle it by means of horse forks or slings, are usually classed as homemade stacking outfits, since the material used for their contruction is usually assembled on the farm.

THE OVERSHOT STACKER.

The overshot stacker (fig. 2) is so called because the hay is carried up and over the stacker frame and delivered at one point on the stack. This necessitates considerable moving of hay by hand when the stack is large. The overshot stacker is simple in construction, efficient in operation, inexpensive, both in first cost and in upkeep, and is sometimes homemade, especially in the West, where haying is done on a large scale. Nearly all stackers of this type are made of wood, and most of them are mounted on a heavy frame which serves as a sled to move the stacker from place to place. One kind of overshot stacker is made with an inclined front, up which the head carrying the hay, mounted on small wheels, travels to the top, whence the hay is dumped on the stack.

Some makes of the overshot type are mounted on wheels; often the running gears of a wagon are used (fig. 2). This feature prevents loss of time in moving the stacker, especially if the distance is considerable.

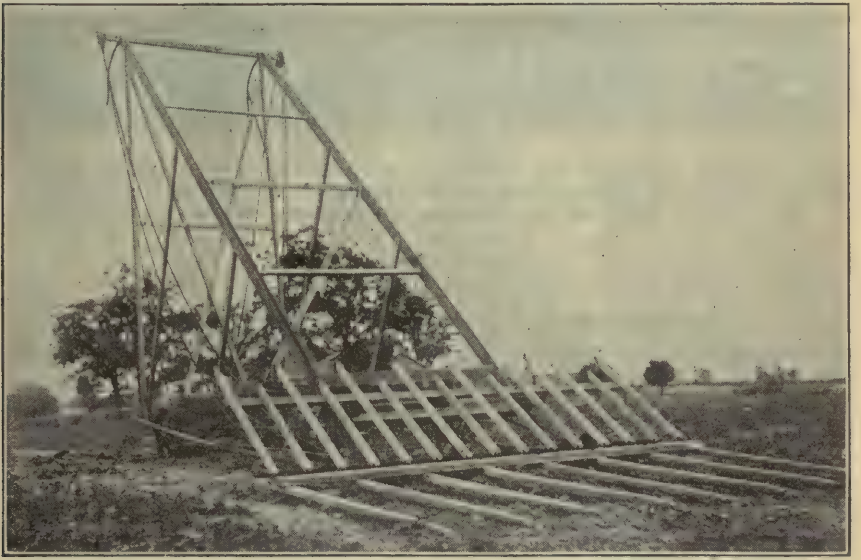

Fig. 2.—The "overshot" stacker is in general use in the Middle West, and can be used for large or small stacks. This type is mounted on wheels, and very little time is lost by the crew when it is moved to a new stack site.

A device consisting of springs or weights that counterbalance the weight of the stacker head while the latter is returning to the ground after the hay has been dropped on the stack is a very desirable feature. Without it, the team must be backed slowly, holding the weight of the empty head until it reaches the ground. This causes loss of time and lessens the capacity of the stacker.

THE SWING-AROUND STACKER.

The principal advantage of the swing-around stacker over the overshot type is its ability to deliver the load of hay to different parts of the stack, thus reducing the amount of work required on the stack (fig. 3.) The swing-around stacker can also be used to advantage in certain kinds of hay barns, when the hay is brought to the barn with push rakes.

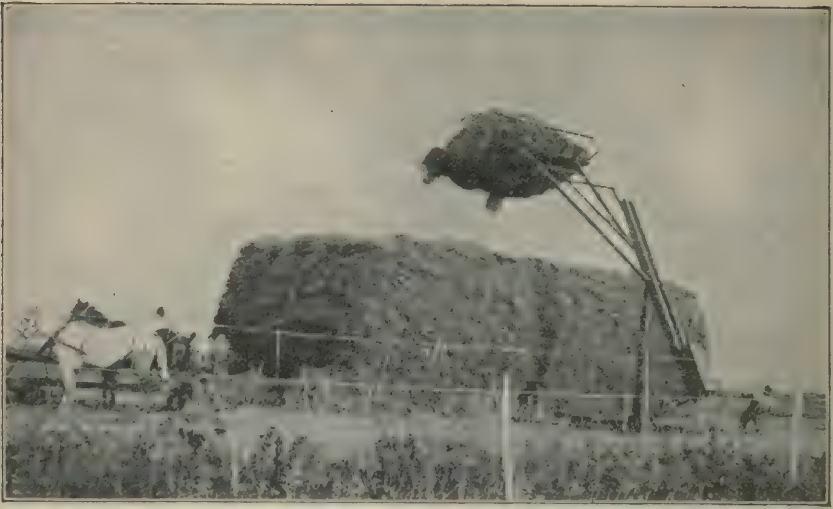

FIG. 3.—The "swing-around" stacker is a very efficient and popular type. The weighted box on the lower end of the swinging arm is used to counterbalance the weight of the head. Better types than the one here represented are now in use.

THE COMBINATION STACKER.

A combination of push rake and stacker does the work of both. It can be be used to take the hay from the windrow, swath, cock, or push rake, and place it on the stack in the same manner as does the overshot stacker, but on any desired part of the stack. (See figs. 4, 5, and 6.) It can be used to advantage to load hay from the windrow or cock on wagons when labor is scarce, or when the distance is too

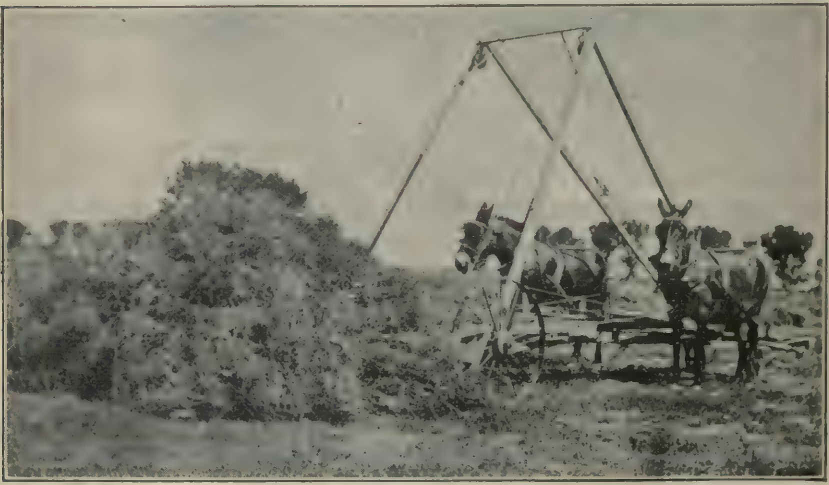

FIG. 4.—Combination stacker taking hay from windrow. The hay is taken directly from windrow to stack when labor is scarce and the distance hauled is short.

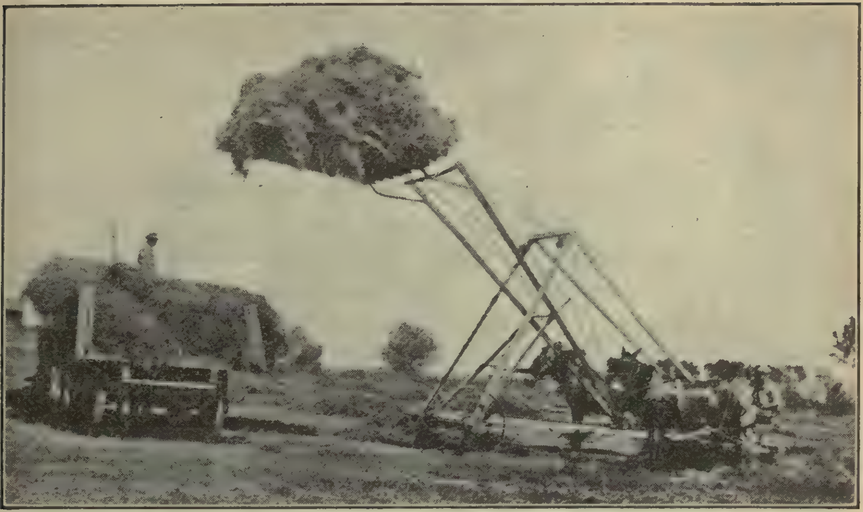

FIG. 5.—A combination stacker loading a wagon in the field. It takes the hay from the bunch or cock and as it is being moved forward a few feet the hay is elevated and dropped on to the wagon. It is not necessary to elevate the hay as high as is shown in the picture.

great to haul the hay with the stacker or the push rake. Its most common use, however, is at the stack, where it handles the hay brought in by push rakes. About half of the owners of this type of machine use it to take the hay directly from the push rake; the others take the hay from piles that have been dropped near the stack by the push rake.

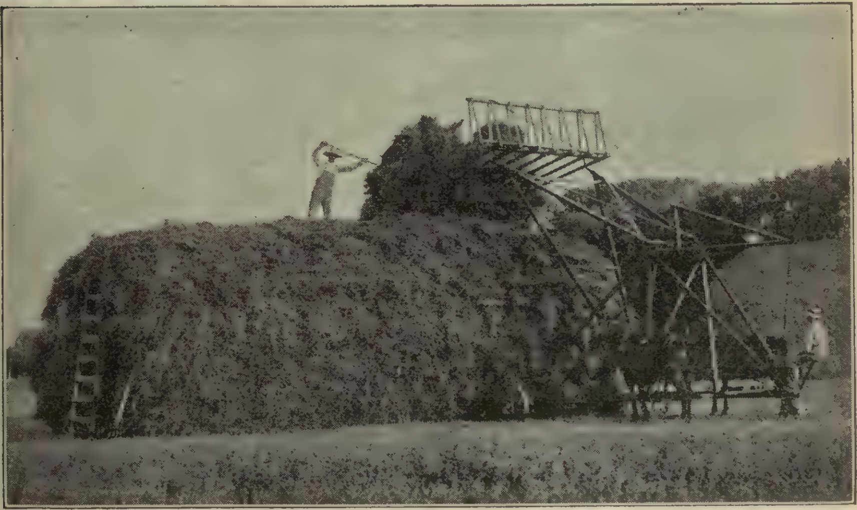

FIG. 6.—The combination stacker putting hay on the stack. It can place the hay on the stack from either side or end, and the direction of the wind does not affect its usefulness in the least. Stacks a little more than 20 feet high can be made with this outfit.

THE CABLE STACKER.

The cable stacker is one of the simplest and most generally used homemade haying appliances. The A-shaped frames (fig. 7) usually are made from poles that can be obtained on the farm or nearby. The remainder of the material can be purchased ready for use from hardware dealers or mail-order houses. The material that must be bought for this outfit consists of 1 reversible cable carrier; 1 double harpoon fork, or grapple fork, or the required number of slings; 150 feet of half-inch galvanized steel cable, on which the carrier travels and which is used also for end guys; 2 cable clamps; 2 long bolts to bolt the tops of the poles together; 3 steel-yoke, knot-passing pulleys; 130 feet of three-quarter inch manila carrier rope, and 65 feet of trip rope. The height of the stack which can be built with this outfit depends upon the length of the poles used. Poles 32 feet long will serve for most conditions.

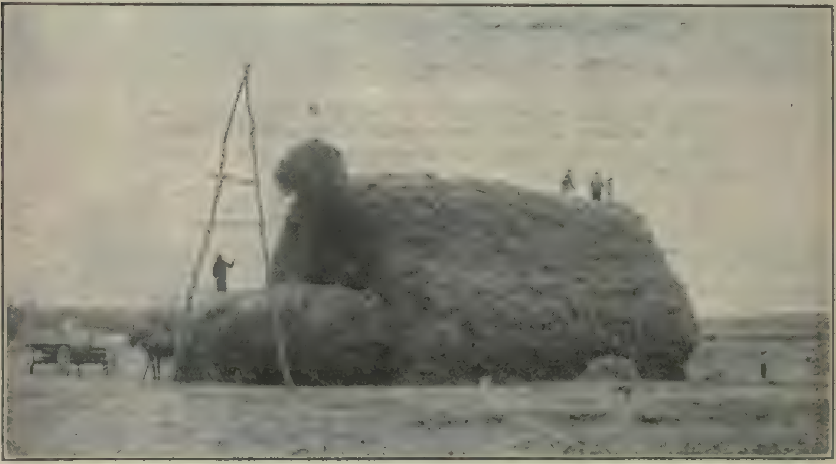

FIG. 7.—Stacking hay with a cable stacker. This is a homemade outfit. The amount of hay damaged by the weather will be very small in a large, well-built stack like this.

POLE OR DERRICK STACKERS.

The single-pole or derrick stacker is used to a considerable extent in the Middle West and West. It consists of a single pole, long enough to make a stack of the desired height, to which is fastened a shorter pole (or boom) at right angles. (See figs. 8 and 9.) It is usually necessary to use three or four guy wires to make the top stable. Three pulleys, about 100 feet more or less of carrier rope, and a horse fork complete the outfit. Some are mounted on wheels (fig. 10), while others are mounted on a wooden platform having sled-like runners.

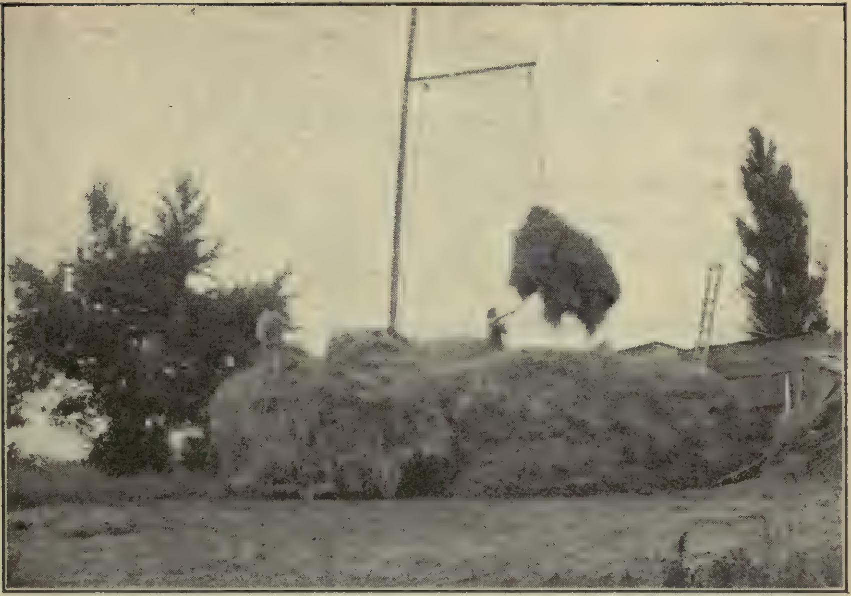

FIG. 8.—A simple, homemade pole stacker, capable of making a very tall stack. As the hay leaves the wagon the stacker turns and the hay is swung over the stack and dropped at the point desired. Stackers of this type must be held by heavy wire guys.

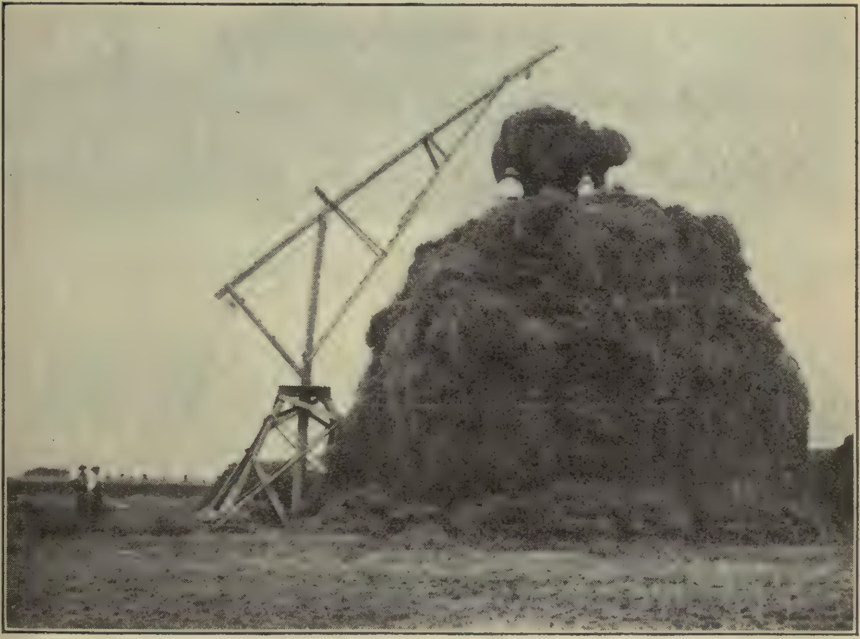

FIG. 9.—Homemade derrick stacker. This stacker is built on a heavy base made of poles. It is braced from below, which does away with the necessity of using guy wires such as are used in figure 8. This is a very poorly built stack. Stacks are sometimes built as loosely as this in the semi-arid West, but in the East or South the loss due to rain would be very great.

TRIPOD STACKERS.

The tripod stacker is the simplest and most easily made of all homemade stackers. Three poles about 30 feet long are bolted together at the top (fig. 11). The bottom is spread out far enough to permit a stack of the desired size to be built under the tripod. The equipment consists of three pulleys, a hay rope, a trip rope, and a horse fork. It is not necessary to use guy wires to hold the tripod stacker in place.

COST OF STACKERS.

Stackers are comparatively inexpensive. The most costly types, the overshot and the swing-around, may be bought for from $45 to $75, and homemade types may be made for a few dollars. If the poles are cut on the farm, the homemade tripod or derrick stacker need not cost any more than an ordinary barn hay fork without the track. Indeed, the fork and rope from the barn may be used in rigging up such a stacker.

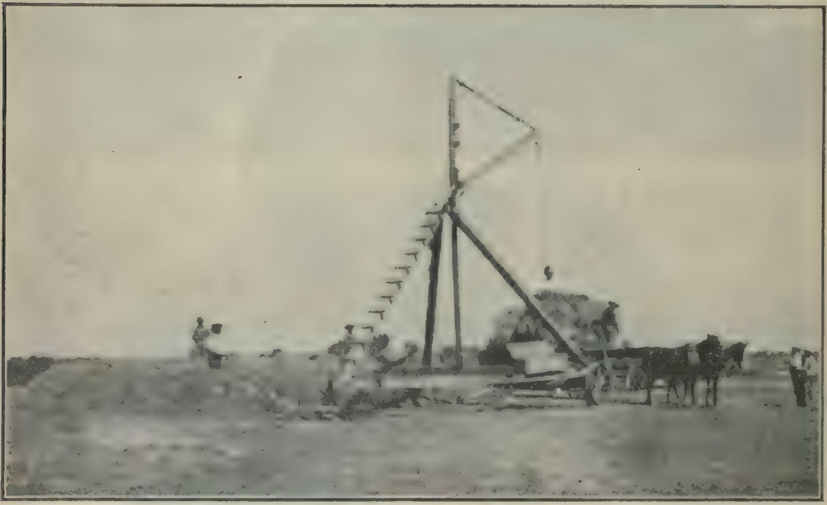

FIG. 10.—A large, heavily constructed, homemade derrick stacker mounted on wheels. This stacker can handle very large forkfuls of hay and can be moved quickly to a new stack site.

The cost of repairs, interest on investment, and replacement charges on stackers depend upon the amount of hay handled per year; the more hay handled per year the less the amount of these charges per ton. A stacker will last from 10 to 12 years under ordinary conditions. The charges for stackers on 27 farms in central Kansas, which stacked an average of only 144 tons of hay per year, amounted to less than 7 cents per ton when the yield was 1 ton per acre. The charges on 32 farms in central Nebraska, when twice this amount or 300 tons of hay were stacked per year, amounted to 3 cents per ton with a yield of 1 ton per acre.

SIZE AND MANAGEMENT OF STACKING CREWS.

The use of the stacker requires considerably less man labor than pitching the hay on the stack by hand, though it necessitates the use of more horses. The amount of hay stacked per man per day is greatly increased.

When the stacker is used, the composition of the crew is often changed advantageously. To get the hay on the stack, the cable stacker or the derrick stacker requires but one man to handle the horse fork or slings, and a boy, girl, or woman to drive the stacker horse or team. The overshot stacker and certain makes of swing-around stackers require merely a boy, girl, or woman to drive the stacker team. The cable and derrick types require one man less than the number generally used when a small crew stacks by hand, and the overshot type does away entirely with the necessity of man labor in getting the hay on the stack. The combination push rake and stacker is operated by one man or boy and two horses, and when it is used fewer men are needed on the stack than when the overshot stacker is used, for the reason that this implement places the hay on any desired part of the stack.

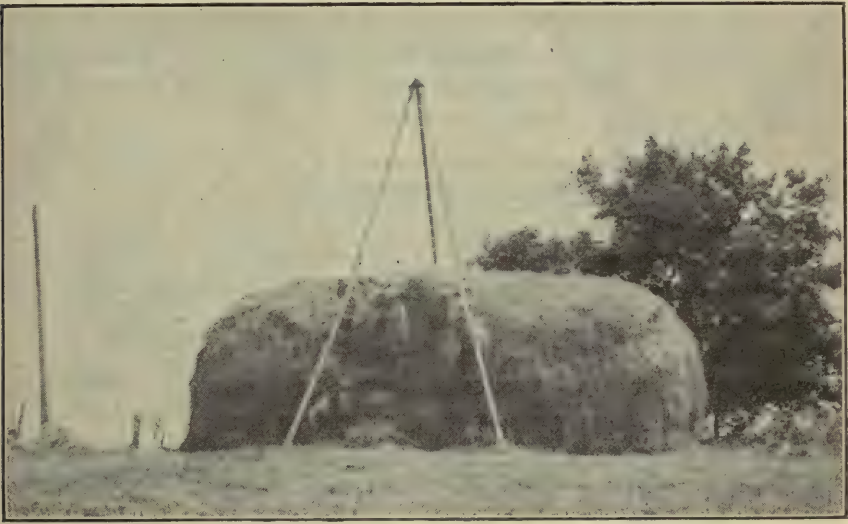

FIG. 11.—A tripod stacker which can easily be made on the farm. It is self-supporting and can be taken down and moved easily but not so quickly as those mounted on wheels. Stacks larger than this are seldom built by the small crew using a tripod stacker.

LOADING AND UNLOADING BY HAND A SLOW METHOD.

On most farms in the East and South, hay that is stacked is pitched on wagons by hand and pitched by hand from the wagon to the stack. The 3-man crew, or some multiple of this unit, is used almost exclusively. With this crew two men pitch the hay on the wagon to the third, who builds the load. When the load is on, all go to the stack, where two men pitch it to the third, who builds the stack. A 3-man crew stacking hay in the East will handle about the same amount of hay per day as when hauling and putting hay into the barn.

When hay is loaded by hand and unloaded with a horse fork or slings, the efficiency of a 3-man crew is increased from 30 to 50 per cent over the method of both loading and unloading by hand.[1] These figures apply to eastern conditions, where hayracks are used. On some farms in the South, hay is often hauled in wagon beds or on wood racks. In such cases the load often does not exceed 500 or 700 pounds and the amount of hay handled per man per day is much smaller than when hayracks are used. It is a waste of time and labor when such small loads as these are hauled.

The overshot, swing-around, and combination types of stackers are not adapted to unloading hay from the wagon, but all other types described are suitable for this purpose.

USING HAY LOADER AND STACKER A BETTER METHOD.

A hay loader and either the cable, derrick, or tripod stacker make a good combination for putting up hay, and one operating more efficiently than the first method described, since more hay can be handled per day by a small crew, and one man may be dispensed with. Two men and one boy constitute the loading, hauling, and stacking crew. The boy drives and the two men build the load on the wagon as it is delivered by the loader. At the stack, one man stays on the wagon to handle the horse fork or slings, as the case may be, one man works on the stack, and the boy drives the team hoisting the hay. When several wagons are used, the men who build the load remain in the field and a crew is kept working continuously at the stack, eliminating any loss of time in traveling to and from the stack.

The use of the loader and stacker will increase the efficiency of a small crew about 20 per cent over that of a crew loading with a loader and unloading by hand. Two men and a boy using a loader and stacker will handle about 75 per cent more hay per man per day than a 3-man crew loading and unloading by hand. To handle the greatest amount of hay possible, when using the loader, fairly large hayracks should be used. It is much easier and quicker to load a ton of hay on a long, wide rack, than on a short, narrow rack.

STACKING WITH PUSH RAKE AND HAND FORKS, AN INEFFICIENT METHOD.

A few farmers in the Middle West, whose acreage of hay is small, bring the hay to the stack with a push rake but pitch it on to the stack by hand. This practice is often found in certain parts of the

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[1] United States Department of Agriculture Bulletin 412, The Normal Day's Work of Farm Implements, Workmen, and Crews in Western New York.

South where the growing of hay for the market is beginning to be a leading farm enterprise, and where the farm acreage in hay is much greater than that of the Middle Western farmer who does not use the stacker.

When stacking is done by hand and a push rake is used, the crew consists of four men and two horses. One man and a team operate the push rake all day and have no difficulty in bringing 12 or more tons to the stack. One man builds the stack, and each of the two pitchers pitches one-half the hay until the stack is about half made. Up to this point the push rake is kept fairly busy, but now the entire crew's efficiency is reduced 50 per cent. A wagon with an empty hayrack is then placed at the side of the stack and one man pitches to the other pitcher, on the wagon, all the hay required to finish the stack; the man on the wagon in turn pitches it to the stack. The pitchers work just as hard as formerly, but they handle only half as much hay as before, and during this time the push rake is doing only half as much work as it did before the wagon and rack were brought into use.

On 15 farms where this method of stacking was used, one push rake brought, on an average, 12½ tons of hay per day from the cock to the stack. This amount of hay was often put into three or four small, round stacks, a practice entailing serious loss due to weather.

STACKING WITH PUSH RAKE AND STACKER, THE BEST WAY.

Stacking hay with push rake and stacker is by far the most efficient method. It requires fewer men to stack a given amount of hay per day than any other method, if the crew is organized properly. The amount of hay stacked per adult man, which is the proper measure of efficiency, is shown for the different methods in Table I.

TABLE I.—*Tons stacked per adult man per day, stacking by hand vs. stacker.*

Crew.	Method.	Tons stacked per adult man per day.
No. 1	Wagon loaded and unloaded by hand (3 men)	2.93
No. 2	Hay brought to stack with push rake, pitched on to stack by hand (4 men)	3.12
No. 3	Wagon loaded with hay loader, unloaded by hand (3 men)	3.26
No. 4	Wagon loaded by hand, unloaded with stacker (3 men)	4.12
No. 5	Wagon loaded with hay loader, unloaded with stacker (2 men, 1 boy)	5.87

The efficiency of hay stackers adapted to unloading wagons, i. e., cable, derrick, and tripod stackers, is shown by crews Nos. 4 and 5. The use of the stacker and hay loader (crew No. 5) offers a striking example of improvement over old methods of stacking. Even better results than this are obtained when push rakes are used, in connection with the overshot, swing-around, or combination stacker. all of which are made especially to be used with the push rake.

SIZE OF CREW AND DISTRIBUTION OF LABOR.[1]

The distribution of labor is given in Table II, showing the size of crew and kind of work done by each member of the crew, for 11 crews, ranging in size from a small 2-man crew to a large 10-man crew, together with the amount of work accomplished in stacking hay, cured in large cocks, when the yield is 1 ton per acre. Crews such as these are used in the Middle West and West. Some of the crews, as for instance Nos. 5 and 8, will not be used under certain conditions when the yield is 1 ton per acre or more. In each of these crews it has been assumed, for the sake of comparison, that a push rake will handle 12½ tons of cocked hay per day, since this is the average amount handled on a number of farms on which practice with the push rake has been studied. In actual practice, however, the amount handled per push rake will vary both ways from this amount.[2]

TABLE II.—*Distribution of labor in 11 stacking crews.*

Crew.	Men.	Boys.	Horses.	Tons stacked per day.	Men on stack.	Push rakes used.	Man hours per ton.	Team hours per ton.	Tons stacked per man per day.
No. 1	2	1	4	12.5	1	1	2.00	1.60	6.25
No. 2	3	1	6	25.0	1	2	1.40	1.20	8.33
No. 3	4	1	6	25.0	2	2	1.80	1.20	6.25
No. 4	5	1	8	37.5	2	3	1.46	1.06	7.50
No. 5	6	1	10	50.0	2	4	1.30	1.00	8.33
No. 6	6	1	8	37.5	3	3	1.73	1.06	6.25
No. 7	7	1	10	50.0	3	4	1.50	1.00	7.14
No. 8	8	1	12	62.5	3	5	1.36	.96	7.81
No. 9	8	1	10	50.0	4	4	1.70	1.00	6.25
No. 10	9	1	12	62.5	4	5	1.52	.96	6.94
No. 11	10	1	14	75.0	4	6	1.40	.933	7.50

In stacking hay with push rake and stacker, if not enough men are used on the stack they will be overworked and the push rakes will be idle a part of the time, while if too many are used the push rakes will not be able to keep them busy. In either case labor will be wasted.

The smallest possible crew for this method is composed of one man on the stack, a boy to drive the stacker team, and one man with push rake. This crew will put 12½ tons in the stack a day (see crew No. 1, Table II), which is at the rate of 6¼ tons per adult man per day. This is not a very economical small crew, but it handles hay faster than a 3-man crew can, following any of the above-mentioned methods in which hand labor is used.

On many farms in the Middle West one man on the stack will handle the hay brought by two push rakes, which is at the rate of 8.33 tons per adult man per day (see crew No. 2, Table II).

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[1] See United States Department of Agriculture Bulletin 578, A Study of Haymaking Crews and Labor Costs, for full discussion.

[2] Complete information on the use of the push rake is published in Farmers' Bulletin 838, United States Department of Agriculture, Harvesting Hay with the Push Rake.

It is seldom that one man stacking is able to keep up with three push rakes. This can be done, however, if the stacker is experienced, or if the yield is light, say one-half ton to the acre, and the push rakes bring the hay to the stack at regular intervals so as to give the stacker time enough to stack the hay properly. Beginners in the use of the stacker, especially if the labor obtainable is not of the best quality, will probably get the most satisfactory results by using more men on the stack than are indicated in Table II, at least until the men become accustomed to the work.

When four push rakes are used, and the yield is 1 ton per acre or better, it is customary to use three men and sometimes four on the stack. When four to seven push rakes are used, it will be necessary to use four men on the stack, as the stacker is kept fairly busy bringing up the hay to the stack, and this necessitates a man for each corner of the stack.

It is seldom that more than six or seven push rakes are used. In order to use this number efficiently the stacker should be mounted on wheels so that it can be moved quickly, since it may be necessary to move it once or twice a day. When a new stack is started, some of the push rakes should begin to bring in hay from distant parts of the field, while others work nearer the stack; thus they will be able to keep the hay coming in steadily. This number of push rakes is too large to be used except on farms where hay is grown on a large scale.

A crew using three or four push rakes will be found about the right size for farms growing from 100 to 200 acres of hay.

In some instances it will be found necessary to have one or more extra men in addition to those who are engaged in operating push rakes, or working on the stack. With some types the stacker requires the services of a man to operate it. Again, when several push rakes are used, especially by "green" men or teams, it will be necessary to use one man to clean up the hay dropped by the push rake in unloading around the front of the stacker. The amount that each additional or extra man adds to the total man hours required for stacking a ton of hay, in each of the 11 crews in Table II, is shown in Table III.

TABLE III.—*Effect of one extra man on amount of labor required for stacking.*

Crew.	Man hours per ton to be added to total man hours in Table II.	Crew.	Man hours per ton to be added to total man hours in Table II.
No. 1	0.800	No. 7	0.200
No. 2	.400	No. 8	.160
No. 3	.400	No. 9	.200
No. 4	.266	No. 10	.160
No. 5	.200	No. 11	.133
No. 6	.266		

When an extra man is added to a small crew, the labor requirements per ton stacked are greatly increased, whereas the addition of a man to a large crew adds little to the labor required per ton. If an extra man is added to crew No. 1, Table II, composed of 2 men and a boy, he adds eight-tenths of a man hour to the amount of labor required to stack a ton of hay. When an extra man is added to crew No. 11, Table II, composed of 10 men and 1 boy, he adds only a little over one-eighth of a man hour per ton.

When several push rakes are used and they are working fast, more or less hay will be left in front of the stacker. Keeping this hay cleaned up is a very light job, which can be done by a boy. Where there is a boss or overseer, as in the South, this work may be done by him, as he must be on the job all the time anyway, and will thus be where he can direct push rake drivers and keep the hay coming in steadily.

SIZE OF STACK.

The amount of hay put into the stack has an important bearing upon the efficiency of the crew. The size of stack depends upon type of stacker used, yield, number of men working on the stack, and amount of hay brought to the stack per hour. It is scarcely economical to build anything smaller than a 10-ton stack when using a stacker.

STACKS MADE WITH CABLE STACKER.

To move and set up a cable stacking outfit requires considerable time, and fairly large stacks ordinarily should be made in order to prevent a loss of time by the crew while waiting for the stacker to be moved. The ordinary cable stacker is capable of making ricks up to 40 feet in length, although longer ricks can be made when an extra long cable is used. The width of the rick varies from 12 to 20 feet, and the height from 20 to 30 feet. The contents of the stacks may be anywhere from 10 to 30 tons or more. When the amount of hay stacked per hour or per day is known, the size of the stack may be regulated so that it will be finished about noontime or by evening. If this is done the crew will lose little time, since the stacker can be taken down and moved in the morning, while the crew is waiting for the dew to dry off, or at noon, or even late in the evening after the day's work is done.

STACKS MADE WITH DERRICK STACKERS.

The size of stacks made by the different types of derrick stackers varies considerably. Small stackers of this type are often too low to permit the building of tall stacks, but some of the larger stackers used in the West build stacks higher than the cable stacker. Ricks made by derrick stackers are, in general, not as long as those made by the cable stacker, because of the large amount of labor required in moving the hay to the ends of the rick. Long ricks sometimes are made by making a rick of moderate length, say 30 feet, and then moving the stacker so that the next stack can be joined to the first one. This practice is not to be recommended, unless it is necessary to move the hay to a high point to avoid injury by overflow water, or to place the hay where it will be handy for feeding, as is done in the West by cattle or sheep feeders.

STACKS MADE WITH TRIPOD STACKER.

The tripod stacker usually is not adapted to making long, high stacks, and very often is used by small crews. This stacker, as well as the cable and derrick types, is generally used for stacking hay that is hauled to the stack on wagons. The tripod stacker is easier to move than the cable stacker, or than the derrick that requires the use of guy wires, and for this reason it is generally used for building comparatively small stacks.

STACKS MADE WITH THE OVERSHOT AND SWING-AROUND STACKERS.

The overshot stacker is perhaps better adapted to building stacks of different sizes than any other type. It is much more popular with the average hay grower. It can be used with a small crew or a large one, and, when mounted on wheels, can be moved to a new stack site in a few minutes, with hardly any loss of time on the part of the crew. With this outfit, stacks ranging from 5 to 30 tons or more can be built.

With the swing-around stacker, the same sizes of stacks can be made as with the overshot.

STACKS MADE WITH COMBINATION STACKER.

Ricks of any desired length can be made with the combination stacker without necessitating any extra labor on the stack, because this type of stacker places the hay on any desired part of the stack, and from either side or end. It can be used to build very small stacks as easily as long ricks. The extreme height of stacks made with the combination stacker is from 20 to 23 feet. Many users of this type claim that when it is worked to its capacity, one or two less men are needed on the stack than when stacking with the overshot stacker.

EFFECT OF YIELD ON SIZE OF STACK.

Size of stack is often dependent, more or less, upon the yield of hay, especially when hay is brought to a stack with push rakes, but not when hay is hauled on wagons. Given a fixed number of push rakes, it will be found that larger stacks are, or should be, built when the yield is heavy than when it is light, since building large stacks with a small yield entails a considerable waste of labor.

If the yield is 1½ tons per acre, if three men are working on the stack, and if three push rakes are used, the three push rakes will easily handle 10 tons each per day, making a stack containing 30 tons of the hay from 20 acres. Under conditions just mentioned, all the men in the crew will be kept busy all the time. If the yield of the next cutting (Johnson grass and alfalfa mixed, for example) happens to drop down to half a ton per acre, it will require the hay from 60 acres to make a 30-ton stack. Each push rake will have to cover 20 acres instead of 6⅔ acres, and, consequently, can not bring the hay to the stack as fast as when the yield was three times as much. To build a stack of the same size will, in this instance, result in less hay being stacked per hour than with the heavier yield, and the stacking crew will be idle a part of the time while waiting for hay to be brought to the stack. Even if more push rakes are added, so as to keep those working at the stack busy all the time, the cost of using the push rakes for such long distances is so great that this plan is never followed by a haymaker who understands his business.

The thing to do in a case like this is to build stacks containing 10 to 15 tons and to move the stacker oftener, rather than to move hay from such a large area to the stacker.

ARRANGEMENT OF CREW AFFECTS SIZE OF STACK.

The length and breadth of the stack that can be built by a given number of men depend upon the amount of hay each man has to handle per hour and also upon whether the hay comes in steadily at fairly regular intervals. If the hay is coming to the stack just fast enough to keep two men busy when building a rick 12 by 20 feet, it would be impossible for them to build a larger rick, for instance, one 18 feet wide and 40 feet long.

No rule can be given for ascertaining the best size of stack to build with a given crew, because many things influence the working of crews. In Kansas and Nebraska, when making alfalfa hay with a yield of 1 ton per acre, one man often stacks the hay brought in by three push rakes. On many farms it is the custom to have one man on the stack for each push rake, up to four men on the stack, which are about as many as can work efficiently. When two men and three push rakes are used, the 15 to 20 ton stack is the size most often built by those who are experienced in haymaking. When three or four men are used on the stack they usually build larger stacks, containing 20 tons or more.

The amount of work done by different men when stacking hay varies widely. Some are very skillful and others do not have the knack of handling hay on the stack. A considerable variation occurs also in the amount of hay a man and team will bring to the stack. Owing to these facts, those using stackers for the first time can not hope to start right out and build a given-sized stack in a given length of time. After the crew has become accustomed to the work, and to working together, and when everything begins to go smoothly, the hay grower or manager by taking careful note of the increase or decrease in the amount of hay made, can begin to make adjustments until the crew is doing the greatest amount of work possible without overworking either man or horse.

LOCATING STACKS.

Stack sites should be definitely chosen before haying operations begin. The stacker should never be set until the effect the location may have on the efficiency of the crew has been considered carefully. Three points should always be kept in mind when locating stacks, namely, (1) effect of location on total distance traveled in bringing the hay to the stack, (2) lay of the land and its influence on ease of hauling the hay to the stack, and (3) danger of loss of hay in the bottom of the stack due to surface water or ground water.

AVOID LONG HAULS.

Long hauls should be avoided whenever possible, especially when hauling with push rakes. It is very common, on farms where hay is hauled with a wagon and stacked by hand, to see stacks of hay at the end or corner of the field nearest the farm buildings, the site being chosen in order to have the hay handy for feeding.

With push rakes this practice will seriously affect the size and efficiency of the crew. The total distance traveled in bringing hay to one side of a square field is approximately 50 per cent greater than in hauling to the center. If the stack is located at one corner of the field, the total distance traveled is 100 per cent greater. It is necessary to travel about 30 per cent farther in bringing hay to the corner of a square field than to bring it to a side of the field. If four push rakes are kept busy in bringing hay to the center of a square field, six will be required to bring the same amount of hay to the end of the field, and eight to bring the same amount to a stack located in the corner, if it is to be stacked in the same length of time as when stacking in the center of the field.

TAKE ADVANTAGE OF THE LAY OF THE LAND.

To haul hay up hill reduces the amount handled per day, as a well-loaded push rake, especially of the three- or four-wheel type, is usually a load for an ordinary team on level land. In order to have a down-hill haul, it is sometimes a good practice to locate the stack away from the center of the field, thereby decreasing the labor requirement, though increasing the total distance the hay is hauled.

AVOID STACKING IN LOW PLACES.

Stacks should not be located in low or marshy places. Stacks near creek beds are often subject to considerable damage by freshets. To avoid loss of this kind, stacks should always be built on dry, well-drained ground, even though the hay must be hauled a little farther than otherwise would be necessary.

BUILDING THE STACK.

THE STACK BOTTOM.

To minimize damage by moisture from the ground, care should be taken to keep the hay in the bottom of the stack from coming in contact with the soil. Usually more or less spoiled hay is found in the bottom of a stack that has stood for a considerable time. Such loss may be greatly reduced or altogether avoided by placing old rails, poles, boards, or even straw on the ground so as to keep the bottom of the stack dry.

SETTING THE STACKER.

In setting stackers, the direction of the prevailing wind should be considered. The setting of a cable stacker or a derrick stacker can not be changed easily, because the "dead men" to which the guy wires are attached are usually buried deep in the ground, and to move them requires considerable time. Stackers are usually set to stack with the wind. The combination stacker can be used at either side of the stack, depending on the direction of the wind.

Derrick or pole stackers should be set so that the upright part is perpendicular. The bottom should be level. It is especially necessary that the overshot stacker mounted on wheels be set level, because it will not work to best advantage otherwise and, if much out of level, may be blown over when taking up a full load.

SHAPING THE STACK.

To build a good, symmetrical stack when using a hay stacker requires practice. Hay pitched from a wagon is put on the stack a forkful at a time, which allows plenty of time for the man on the stack to place each forkful and tramp it down. The stacker, however, drops upon the stack larger bunches of hay, which must be quickly spread out or rolled into position without being tramped very much. The weight of the falling hay tends to settle the hay in the middle of the stack, which is a help to those building the stack.

The aim of all good stack builders is to make a stack that will not "take water;" that is, one built so as to shed water away from the center and toward the sides or edges of the stack. This end is accomplished by tramping the middle well and always keeping it higher than the edges. If this it not done, rain will be directed to the interior of the stack, and serious loss may result.

The shape of the stack has a direct bearing upon the tendency of the stack to take water, and the percentage of hay liable to be damaged. Nine end views representing the ordinary shapes of stacks or ricks are shown in figure 12. Stack No. 1 is perhaps the poorest shape. Stack No. 9 represents a shape in which the loss due to the weather will be least, provided it is built properly. The other seven shapes represent various intermediate types.[1]

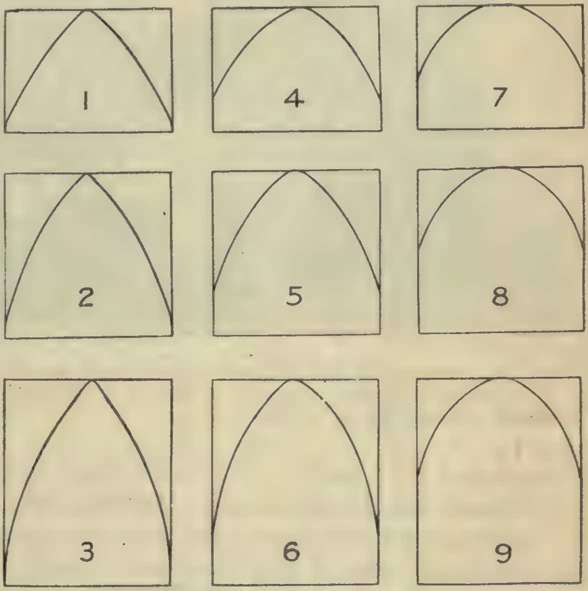

FIG. 12.—End views of different kinds of hay stacks or ricks. The loss of hay due to damage by sun and rain will be greatest in shape No. 1, and least in shape No. 9.

PROTECT THE TOP OF THE STACK.

The stack should be well topped out and the sides should be raked down with a garden rake or pitchfork to prevent rain from entering the sides. In sections subject to high winds the top should be held in place until the stack is settled. This is done with weights attached to wire, thrown at intervals across the top of the stack. Old fence posts, tile, or rocks may be used for weights.

Canvas stack covers are used by some good haymakers, practically eliminating loss from rain. A more desirable protection of this kind consists of sheets of corrugated galvanized iron roofing, which can be bought properly curved for this purpose. These are easy to put on, will keep all the rain off the stack, and will last for years. (Fig. 13.)

TEMPORARY OR EMERGENCY STACKS.

Mixed alfalfa and Johnson grass hay is sometimes put in temporary or emergency stacks during unfavorable weather. Such hay is ordinarily cured in large cocks, standing thus until ready to be baled. Continued rainy weather will sometimes wet the hay so that

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[1] Methods of measuring the quantity of hay in a rick are given in Circular 67, Office of the Secretary, United States Department of Agriculture.

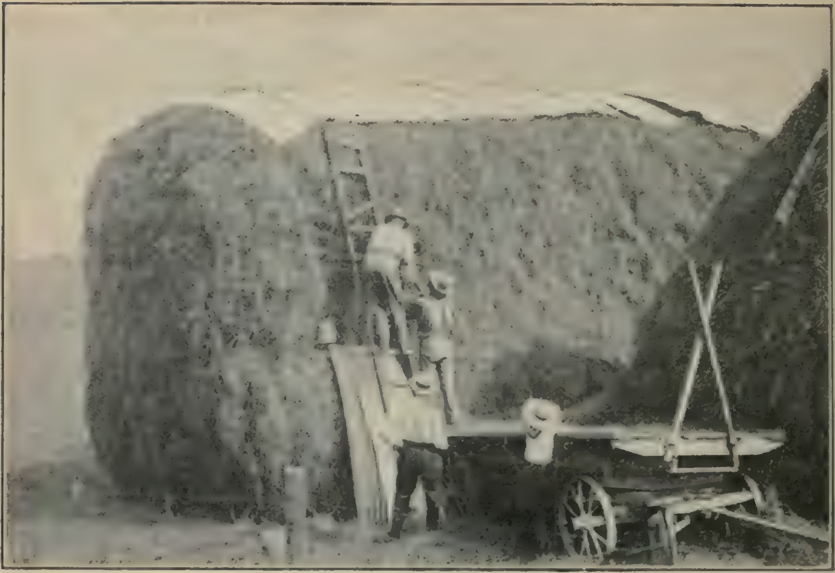

FIG. 13.—Corrugated roofing used to protect hay stacks. The strips are held in place by concrete weights. Covering of this type will last for years and will keep rain from entering the top of the stack.

it begins to heat badly. It then becomes necessary to open the cocks and spread out the hay to dry. If there are indications of more rain by the time the hay is dry, it is put into temporary stacks in order to protect it, since if it is recocked the rain will make it necessary again to open the cocks and spread out the hay. Making temporary stacks is rush work, and every available man is used. The hay is usually hauled to the stack with push rakes and pitched on the stack by hand.

An overshot stacker would greatly facilitate emergency stacking on account of the rain, but the use of hay caps would eliminate such work altogether.

Temporary stacks are often baled within a day or two after they are made and before the hay has gone through the "sweat."

PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE RELATING TO HAY AND FORAGE.

PUBLICATIONS AVAILABLE FOR FREE DISTRIBUTION.

Alfalfa. (Farmers' Bulletin 339.)
Market Hay. (Farmers' Bulletin 508.)
Irrigation of Alfalfa. (Farmers' Bulletin 865.)
Growing Hay in South for Market. (Farmers' Bulletin 677.)
Natal Grass: A Southern Perennial Hay Crop. (Farmers' Bulletin 726.)
Lespedeza or Japan Clover. (Farmers' Bulletin 441.)
Harvesting Hay With Sweep-Rake Means, by Which Eastern Hay Growers May Save Labor. (Farmers' Bulletin 838.)
Red Clover. (Farmers' Bulletin 445.)
Hay Making. (Farmers' Bulletin 943.)
Crimson Clover: Utilization. (Farmers' Bulletin 579.)
Curing Hay on Trucks. (Farmers' Bulletin 956.)
Bur Clover. (Farmers' Bulletin 693.)
Hay Caps. (Farmers' Bulletin 977.)
Button Clover. (Farmers' Bulletin 730.)
Timothy. (Farmers' Bulletin 990.)
Sweet Clover: Utilization. (Farmers' Bulletin 820.)
Cowpeas. (Farmers' Bulletin 318.)
Moisture Content and Shrinkage of Forage. (Department Bulletin 353.)
A Study of Hay Making Crews and Labor Cost. (Department Bulletin 578.)
Farm Practice in the Production of Hay in Steuben County, New York, and Washington County, Pennsylvania. (Department Bulletin 641.)
Vetches. (Farmers' Bulletin 515.)

PUBLICATIONS FOR SALE BY THE SUPERINTENDENT OF DOCUMENTS, GOVERNMENT PRINTING OFFICE, WASHINGTON, D. C.

Forage Crop Practices in Western Oregon and Western Washington. (Farmers' Bulletin 271.) Price 5 cents.
Successful Southern Hay Farm. (Farmers' Bulletin 312.) Price 5 cents.
Conditions Affecting Value of Market Hay. (Farmers' Bulletin 362. Price 5 cents.
Measuring Hay in Ricks or Stacks. (Secretary's Circular 67.) Price 5 cents.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1919

UNITED STATES DEPARTMENT OF AGRICULTURE
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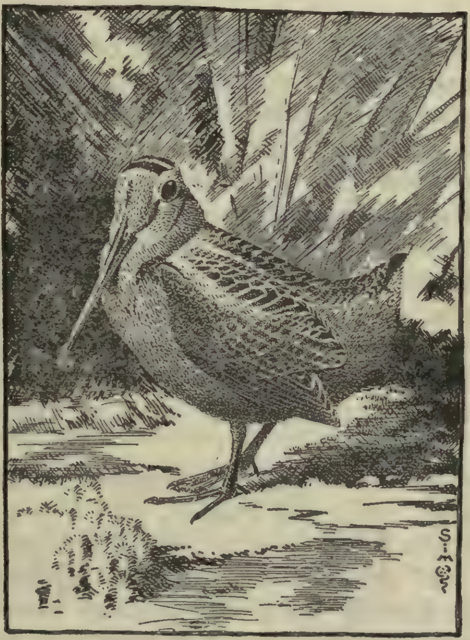
GAME LAWS FOR 1918

A SUMMARY OF THE PROVISIONS OF FEDERAL, STATE, AND PROVINCIAL STATUTES

George A. Lawyer and Frank L. Earnshaw



FARMERS' BULLETIN 1010

UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from the Bureau of Biological Survey
E. W. NELSON, Chief

Washington, D. C. October, 1918

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WASHINGTON : GOVERNMENT PRINTING OFFICE : 1918

THE objects of this bulletin, containing the nineteenth annual summary of Federal and other game laws and regulations, are to present the provisions in convenient form for sportsmen and others, and to show the general condition and trend of game legislation from year to year.

Provisions relating to methods of capture, game refuges, enforcement of laws, disposition of fines and fees, and matters of minor importance are omitted. These may be found by reference to the laws themselves or to pamphlet editions of the game laws, obtainable in most of the States from proper officials.

Provisions relating to seasons, licenses, limits, possession, sale, and export, and a few miscellaneous matters have been compiled and grouped under State and other Governments, alphabetically arranged, thereby enabling persons interested to secure conveniently a brief synopsis of the laws.

GAME LAWS FOR 1918.

A SUMMARY OF FEDERAL, STATE, AND PROVINCIAL STATUTES.

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REVIEW OF LEGISLATION OF 1918.

Fewer game laws were enacted in 1918 than in any year since 1900—about 50 laws having been passed. Eleven States[1] and all the Provinces of Canada held regular legislative sessions. In some States unsuccessful efforts were made to repeal or modify existing protective laws for the duration of the war, and while the laws were slightly relaxed in a few instances, the seasons as a rule were left unchanged or were shortened to give better protection to game that has become greatly reduced in abundance. The United States Food Administration, after carefully considering recommendations received by it on this subject, reached the conclusion that the maximum supply of food can best be obtained by constantly increasing the breeding reserve of game under present laws and even more progressive laws directed toward that end.[2]

BIG GAME.

Existing laws for the protection of big game were continued in all the States. In Nova Scotia the close season on moose and deer expiring in 1918 was continued indefinitely on Cape Breton Island and on caribou and cow moose throughout the Province. Ontario lengthened the open season 10 days on moose and caribou by opening it October 1 instead of October 10, and increased the limit on deer from one to two for a resident of the Province. New Brunswick placed a close season on caribou until 1921 and prohibited the sale of deer and moose. Full protection was given buffalo, elk or wapiti, and musk-ox in the Northwest Territories; and while the open season was shortened two weeks on caribou and sheep, it was extended two weeks on deer, moose, and goats.

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[1] Georgia, Kentucky, Louisiana, Maryland, Massachusetts, Mississippi, New Jersey, New York, Rhode Island, South Carolina, and Virginia. In Georgia, Kentucky, and Mississippi no game legislation was enacted.

[2] Full text of the statement will be found on pages 68–69.

CLOSE SEASONS ON GAME BIRDS.

Owing to the great scarcity of ruffed grouse, now seriously threatened with extinction, efforts are being made in a number of States to close the season on this species for a term of years. Upon petition the game commissioners of Michigan and Pennsylvania have closed the season by regulation, and in New York the season was shortened to one month.

Ontario extended the close season on ruffed grouse until 1920 and Nova Scotia extended it on ruffed grouse and birch partridge until 1922. Alberta opened the season on grouse and Hungarian partridge but confined the shooting season to the month of October. Grouse are protected in New Brunswick until 1921.

The close season has been extended on wood duck in New Jersey to October 1, 1921; indefinitely on swans, wood duck, and eider ducks in Ontario and Nova Scotia; and on eider ducks in Quebec.

MIGRATORY BIRDS.

On July 3, 1918, a law (Pub., 186, 65th Cong.) was enacted by Congress to give effect to the migratory-bird treaty. Upon its passage regulations were prepared and adopted by the Secretary of Agriculture and on July 31 were proclaimed by the President. These regulations[1] fix the open seasons on migratory game birds, prescribe maximum bag limits throughout the United States, permit only two days' bag limit of migratory game birds to be exported from a State by one person in a calendar week, and authorize under permit the propagation of migratory waterfowl in captivity for commercial purposes. The regulations do not permit the sale of migratory birds except waterfowl raised in captivity, anywhere in the United States. This new law also grants the powers necessary for its proper enforcement and permits the several States to make and enforce laws and regulations not inconsistent with the act or to give further protection to migratory birds.

On May 11, 1918, Canada took final action to give effect to the migratory-bird treaty by promulgating comprehensive regulations under the migratory birds convention act (7–8 Geo. V, 1917, ch. 18).[1] It is interesting to note that these regulations prohibit all hunting in late winter, after January 15, and before September 1, except that the open season on shorebirds in the Maritime Provinces opens August 15. The season for hunting is further restricted to a period not exceeding three and one-half months. Seven of the Canadian Provinces already have made their game laws conform with the terms of the Dominion regulations.

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[1] Full text of the regulations will be found on pages 59–65.

ADMINISTRATION.

Probably the most important feature of the 1918 game legislation was the enactment of a law in Maryland prescribing State-wide hunting licenses and creating a game protection fund for the support of the State game department. In New York the payment of moieties to special protectors has been abolished, and the salaries of protectors increased from $950 to $1,000, with a maximum under the merit system of $1,500 instead of $1,300 for those in the first grade, and establishing a maximum of $1,300 for those in the second grade; the title of "Division Chief Game Protector" was changed to "Inspector" and the salary increased from $1,600 to $1,800; the game protectors have been furnished new uniforms, and have been armed with 25–20 Winchester rifles to be used in exterminating vermin and birds of prey. Three men were added to the warden service in New Jersey and the salaries of chief protector, assistant protectors, and wardens are each increased $300 in the aggregate—the increases being apportioned over four years of service.

In British Columbia the work of game protection has been placed in the hands of a game conservation board.

GAME REFUGES AND PRESERVES.

Continued interest is manifested in the establishment of game preserves, and while the volume of legislation of this character is not large it is worthy of mention. The War Department has created the Aberdeen Proving Ground in Maryland consisting of nearly all the territory south of the Susquehanna and north of the Gunpowder River and between the Pennsylvania Railroad and Chesapeake Bay—including some of the finest waterfowl sections on the Atlantic coast—and hereafter no hunting will be permitted thereon. In Rhode Island the commissioners of birds have been authorized to establish State game reservations on private lands by lease or with consent of owners. New Jersey appropriated $5,000 with which to purchase additional land adjoining the State game farm, at Forked River.

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[1] See pages 65–68.

In Canada, Alberta has established two game preserves, the Cypress Hills and the Cooking Lake Forest Reserves.

MISCELLANEOUS LEGISLATION.

A campaign against cats found in pursuit of birds has been authorized by law in New York. This act was the result of a compromise secured by those who desired a provision that cats should be licensed. Efforts to secure cat legislation in Maryland, Massachusetts, and New Jersey were again unsuccessful.

In New York waterfowl may not now be taken with a rifle in the forest preserve counties or on Long Lsland. New Jersey has made it unlawful to hunt from an automobile, or by the aid of lights carried thereon. An act of the Virginia Legislature imposes on game wardens the duty of killing dogs found destroying sheep. Rhode Island has made a distinct advance in game protection by prescribing for the first time a bag limit of not more than 15 game birds in possession.

SUMMARY OF LAWS RELATING TO SEASONS, LICENSES, LIMITS, SALE, AND EXPORT.

The open seasons for migratory game birds appear under the respective States and Provinces. The seasons shown are the times when migratory game birds may be hunted without violating either State laws or Federal regulations.[1] Federal regulations now prohibit shooting from sunset to half an hour before sunrise.

The Federal migratory bird treaty act regulations prohibit throughout the United States the killing at any time of the following birds:

Band-tailed pigeon; common ground doves and scaled doves; little brown, sandhill, and whooping cranes; wood duck, swans; curlews, willet, upland plover, and all shore birds (except the black-bellied and golden plovers, Wilson snipe or jacksnipe, woodcock, and the greater and lesser yellowlegs); bobolinks, catbirds, chickadees, cuckoos, flickers, flycatchers, grosbeaks, hummingbirds, kinglets, martins, meadowlarks, nighthawks or bull-bats, nuthatches, orioles, robins, shrikes, swallows, swifts, tanagers, titmice, thrushes, vireos, warblers, waxwings, whip-poor-wills, woodpeckers, and wrens, and all other perching birds which feed entirely or chiefly on insects; and also auks, auklets, bitterns, fulmars, gannets, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, and terns.

In some States certain days of the week constitute close seasons throughout the time in which killing is permitted. Hunting on Sunday is prohibited in all States and Provinces east of the one hundred and fifth meridian except Illinois, Louisiana, Michigan, Texas, Wisconsin, and Quebec. Mondays constitute a close season for waterfowl in Ohio and locally in Maryland and North Carolina; and certain other week days for waterfowl in several favorite ducking grounds in Maryland, Virginia, and North Carolina. Hunting is prohibited on election day in Maryland in Allegany, Baltimore, Cecil, Charles, Frederick, and Harford Counties; and when snow is on the ground in New Jersey, Delaware, Virginia, and Maryland. The county laws of North Carolina, which are too numerous to be included satisfactorily, are not incorporated in the following summary, which otherwise may be regarded as a practically complete résumé of the regulations now in force.

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[1] The full text of the migratory bird treaty act and regulations will be found on pp. 59–65.

The migratory bird treaty act regulations permit the possession of migratory game birds during the open season and the first 10 days following the close of the season. This provision has been considered in connection with State laws, and when migratory game birds may be legally possessed under Federal regulations and State laws during any part of the close season, it has been stated under the heading "Bag limits and possession." Possession of nonmigratory game during the close season is generally prohibited by State laws, but when an extension of a few days or a special season is provided for either possession or sale, attention is called thereto.

Under the Federal migratory bird treaty act the sale of all migratory game birds is prohibited throughout the United States, except for scientific or propagating purposes, or of waterfowl raised on farms or preserves under proper permit from the Secretary of Agriculture.

In stating the open seasons[1] the plan of the New York law, to include *the first and the last days thereof*, has been followed. The difficulty of securing absolute accuracy in a statement of the seasons is very great, but the following summaries have been submitted to the proper State or provincial game commissioners for approval, and are believed to be free from material errors. Seasons which apply only to special counties are placed to the left of the column containing those for the State in general. Species (except migratory birds protected throughout each year by Federal regulation) on which the season is closed for a term of years or an indefinite period are grouped under the term "No open season." Provisions of State laws prohibiting hunting at night, between sunset and sunrise, or during certain hours, are not included.

Persons are advised to secure from State game commissioners[2] the full text of game laws in States where hunting is contemplated.

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[1] For open seasons on fur-bearing animals, see Farmers' Bulletin —, 1918.

[2] See p. 70. A full list of names and addresses of officials and organizations concerned with the protection of birds and game will be found in Biological Survey Document 109, 1918.

ALABAMA.

Open seasons:

Deer (male)	Nov. 1–Jan. 1.
Squirrel (black, gray, fox)	May 15–June 15. Aug. 1–Jan. 1.
Quail (partridge)	Nov. 1–Mar. 1.
Ruffed grouse (pheasant), introduced pheasant, or other introduced game birds	Nov. 15–Dec. 15.
Wild turkey gobblers	Dec. 1–Apr. 1.
Turtle dove	Sept. 16–Dec. 31.
Duck, goose, brant, black-bellied and golden plovers, Wilson snipe, yellowlegs, coot, mud hen	Nov. 1–Jan. 31.
Woodcock	Nov. 1–Dec. 31.
Rail, other than coot and gallinules	Sept. 1–Nov. 30.

No open seasons: Does, elk (1925); hen turkeys.

Hunting licenses: Nonresident or alien, $15. Resident: State, $3; county, $1. Issued by probate judges. Landlords, tenants, and members of families may hunt on own land during open season without license. Written permission required for hunting on land of another.

Bag limits and possession: One deer, 10 squirrels, 2 turkey gobblers, 25 of each other kind of upland game bird a day; 25 ducks, 8 geese, 8 brant, 15 in all of plovers and yellowlegs, 25 Wilson snipe, 6 woodcock, 25 in all of rails, coots, or gallinules, 25 doves. Possession of migratory birds permitted during first 10 days of close season; other game during first 5 days thereof.

Sale: Sale of all protected game prohibited.

Export: Export of all protected game prohibited, except that a nonresident licensee may take with him, openly, game he has lawfully killed, but not more than 2 days' limit of migratory birds shall be exported in any one calendar week.

State game and fish commissioner may issue $1 permit to any person to capture or transport not more than 10 pairs of any one species of game birds for scientific or propagating purposes.

ALASKA.

Open seasons: [1]

North of latitude 62°—	
Moose (females and yearlings protected all the year), caribou, sheep	Aug. 1–Dec. 10.
South of latitude 62°—	
Deer with horns 3 inches long (southeastern Alaska) see exception	Aug. 15–Oct. 31.
Exception: Deer on Duke, Gravina, Kodiak, Long, Kruzof, San Juan, Suemez, Zarembo, Hawkins, Hinchinbrook, and Montague Islands, 1920.	
Mountain goat in southeast Alaska east of longitude 141° and on Kenai Peninsula	Sept. 1–Oct. 31.
Moose (females and yearlings protected all the year), caribou, sheep (see exception)	Aug. 20–Dec. 31.
Exception: Moose, south Lynn Canal; caribou on Kenai Peninsula; sheep, Kenai Peninsula, east of long. 150°	Aug. 1, 1920.
Ewes and lambs on Kenai Peninsula and north of lat. 60° and west of long. 141°, 1920.	
Brown bear	Oct. 1–July 1.
Throughout Territory—	
Grouse, ptarmigan	Sept. 1–Mar. 1.
Duck, goose, brant, Wilson snipe, black-bellied and golden plovers, yellowlegs, coot, gallinule	Sept. 1–Dec. 15.

No open season: Does and fawns in southeastern Alaska.

Hunting licenses: Nonresident, $50; nonresident alien, $100. Guide, first-class, $25 (American citizen); second class, $7.50 (native of Alaska—fee fixed by governor).

Shipping licenses: Resident, $40 (export of heads or trophies); $10 (single trophy of caribou or sheep); $5 (single trophy of deer, goat, or brown bear). Special license for shipping one moose killed south of latitude 62°, $150.

(Not more than one general ($40) license and two special ($150) moose licenses issued to one person in one year. Each shipper must file with the customs office at port of shipment an affidavit that he has not violated the game law; that the trophy to be shipped has not been bought or purchased, has not been sold, and is not shipped for purpose of sale; that he is the owner of the trophy, and, in case of moose, whether the animal from which it was taken was killed north or south of latitude 62°.)

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[1] *Alaska:* Game animals or birds may be killed at any time for food or clothing by native Indians or Eskimos, or by miners or explorers in need of food, but game so killed can not be shipped or sold.

Bag limits and possession: Three deer, 2 moose, 3 caribou, 3 sheep, and 3 brown bears a season; 25 grouse or ptarmigan, 25 ducks, 8 geese, 8 brant a day, 25 in all in possession; 15 in all of plovers and yellowlegs, 25 Wilson snipe, 25 shorebirds in possession; 25 in all of coots and gallinules a day. Possession of migratory birds permitted during first 10 days of close season.

Sale: Sale prohibited of heads, hides, and skins of all protected game; deer in southeastern Alaska; moose, caribou, sheep, and goats south of latitude 62° and between longitude 141° and a line passing along western outlet of Lake Clark in longitude 155°. Serving deer or caribou on vessels east of Unimak Pass also prohibited.

Sale of migratory birds prohibited.

Permitted: Carcasses of all game (except migratory birds, and deer, moose, and sheep as above stated) may be sold during the open season and 15 days thereafter.

Export: Export prohibited of deer, moose, caribou, sheep, goat, bear, or hides of these animals; wild birds, except eagles, or any parts thereof: *Provided,* specimens may be exported under restrictions imposed by the Secretary of Agriculture and trophies of big game under licenses issued by the governor. (See licenses.)

ARIZONA.

Open seasons:

Deer (male)	Oct. 1–Nov. 1.
Quail (except bobwhite)	Oct. 15–Dec. 31.
Wild turkey	Oct. 1–Nov. 1.
Mourning and white-winged doves	Sept. 1–Dec. 15.
Duck, goose, brant, Wilson snipe, coot, gallinule	Oct. 16–Jan. 31.
Black-bellied and golden plovers, yellowlegs	Oct. 15–Dec. 15.
Rail, other than coot and gallinule	Oct. 15–Nov. 30.

No open season: Does, spotted fawns, elk, antelope, sheep, goat, bobwhite, grouse, pheasant.

Hunting and fishing licenses: Nonresident or alien: Game and fish, $20; birds (except turkeys) and fish, $10. Not issued to applicant under 12 years of age. Resident: Game and fish, $1.25. Issued by game warden or license collectors.

Hunting on own land permitted during open season without license. American-born resident under 17 years of age may hunt without a license, if accompanied by a holder of a general license.

Bag limits and possession: One deer, 2 turkeys a season; 20 ducks, 8 geese, 20 coot, 15 plovers and yellowlegs, and 20 rail, but not more than 20 in all of waterfowl, plovers, yellowlegs, rails, and coots a day or in possession; 25 quail, and 25 doves and white wings a day or in possession; 25 Wilson snipe a day. Possession of plovers, yellowlegs, rails, and doves, permitted during first 10 days of close season; other game during first 5 days thereof.

Sale: Sale of all protected game prohibited.

Export: Export of all protected game prohibited, except for scientific or propagating purposes under permit from State warden.

ARKANSAS.

Open seasons:

Deer (with antlers not less than 5 inches long), bear	Nov. 11–Jan. 10.
Turkey gobblers	Nov. 11–Jan. 10. Mar. 15–Apr. 30.
Quail (partridge)	Nov. 20–Feb. 28.
Duck, goose, Wilson snipe, coot, gallinule	Nov. 1–Jan. 31.
Black-bellied and golden plovers, yellowlegs	Sept. 1–Dec. 15.
Rail, other than coot and gallinule	Sept. 1–Nov. 30.

No open season: Does, fawns, wild turkey hen, pheasant, grouse, prairie chicken, dove, woodcock (1922).

Hunting licenses:[1] For deer and turkey, nonresident, $15, resident, $1.10; for dog in hunting, $1.10. Issued by State treasurer and circuit clerks. Hunting prohibited on inclosed lands without consent of owner.

Bag limits and possession: Two deer, 1 bear, 4 turkeys a season; 15 squirrels a day, 20 quail and ducks in aggregate a day or in possession; 8 geese, 8 brant, 25 Wilson snipe, 15 in all of plovers and yellowlegs, 25 in all of rails, coots, and gallinules a day. Possession of migratory birds permitted during first 10 days of close season; other game during first 15 days thereof.

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[1] *Arkansas:* Fishing licenses: Resident, $1.10; nonresident, general, $5; special 15-day (trip) license, $1.25.

Sale: Sale of all protected game prohibited.

Export: Export of all game (except rabbits) prohibited, provided a nonresident under his license and affidavit that game is not for sale may take with him one day's bag limit.

Commission may permit game to be shipped from the State for propagation.

CALIFORNIA.[1]

Open seasons:

Male deer (except spike bucks), in districts 1, 23, 24, 25, and 26	Aug. 15–Oct. 14.
In districts 2 and 3	Aug. 1–Sept. 14.
In district 4	Sept. 1–Sept. 30.
Bear (black, brown)	Nov. 1–Mar. 1.
Cottontail and bush rabbits, mountain, valley, and desert quail (see exception)	Nov. 15–Jan. 31.
Exception: Mountain quail, districts 1, 23, 24, 25, and 26	Sept. 1–Nov. 30.
Tree squirrel	Sept. 1–Dec. 31.
Grouse	Sept. 15–Oct. 14.
Sage hen (except in district 4 no open season)	Aug. 15–Sept. 30.
Dove (except in district 1, Sept. 1–Oct. 31)	Sept. 1–Nov. 30.
Duck, goose, brant, Wilson snipe or jacksnipe, coot, gallinule	Oct. 16–Jan. 31.

No open season: Doe, spike buck, fawn, elk, antelope, sheep, pheasant, introduced quail or partridge, turkey, rail, plover, yellowlegs.

Hunting licenses:[2] Nonresident, $10; alien, $25; resident, $1; veterans of Civil War, free of charge. Issued by commissioners and county clerks. Unlawful to hunt in inclosure of another without permission of owner.

Bag limits and possession: Two deer, 12 tree squirrels a season; 15 cottontail or bush rabbits a day or 30 a week; 4 grouse a day or 8 a week; 4 sage hens a day or 8 a week; 10 mountain quail a day or 20 a week; 15 valley or desert quail a day or 30 a week; 15 Wilson snipe or jacksnipe a day or 30 a week; 15 mourning doves a day; 25 ducks and 8 geese a day or 50 a week combined; 8 honkers or black sea brant a day or 24 a week.

Possession in excess of weekly limit prohibited. Persons killing deer must retain in possession during open season and 10 days thereafter the skin and the portion of head bearing horns.

Sale: Sale of deer meat and hides and all game birds prohibited.

Hides of deer lawfully killed when duly tagged under affidavit (fee 25 cents) may be sold August 1–December 31. Cottontail and bush rabbits may be sold. Domesticated reindeer may be imported and sold under regulations of fish and game commission.

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[1] *California:* Of the 53 fish and game districts created under the act of 1917, four (1, 2, 3, and 4) are properly hunting districts; 23, 24, 25, and 26 are fishing districts, but are open to hunting; the other 45 are fishing districts or fish and game refuges.

District 1 comprises the northern part of the State, the Sierras, and the east half of the Sacramento and San Joaquin Valleys, including all counties not included in districts 2, 3, and 4.

District 2 comprises that part of the State south of Humboldt and Tehama Counties, west of the Sacramento River and north of San Francisco Bay, including the counties of Mendocino, Glenn, Colusa, Yolo, Solano, Napa, Lake, Sonoma, and Marin.

District 3 comprises the region around the southern portion of San Francisco Bay and the coast counties south of the Golden Gate as far as Ventura, including the counties of Contra Costa, Alameda, Santa Clara, San Francisco, Santa Cruz, Monterey, San Luis Obispo, Santa Barbara, Ventura; also San Benito and the west half of San Joaquin, Stanislaus, Merced, Fresno, and Kern Counties.

District 4 comprises the counties in southern California, namely, Los Angeles, Orange, Riverside, San Diego, Imperial, San Bernardino, and also Inyo and Mono.

Districts 23, 24, 25, and 26, all located in District No. 1, are as follows:

District 23 comprises the drainage area of Lake Tahoe and the Truckee River in the counties of Placer and Eldorado.

District 24 comprises the drainage area of Silver, Twin, Blue, Meadow, and Wood Lakes in the counties of Alpine and Amador.

District 25 comprises the drainage area of Lake Almanor in the counties of Plumas and Lassen.

District 26 comprises Sixty Lake Basin, part of Rae Lake, and to the south fork of Woods Creek, in Fresno County.

[2] *California:* Fishing licenses required of persons 18 years of age and over: Nonresident or alien, $3; resident, $1.

Export: Export of all protected game prohibited, except for scientific or propagating purposes under permit from Board of Fish and Game Commissioner. All shipment by parcel post prohibited.

COLORADO.

Open seasons:

Deer (having horns with two or more prongs)	Oct. 1–Oct. 4.
Rabbit, hare	Unprotected.
Prairie chicken, mountain and willow grouse	Sept. 15–Oct. 1.
Sage chicken	Aug. 15–Sept. 1.
Duck, goose, brant, coot, gallinule, Wilson snipe or jacksnipe, black-bellied and golden plovers, yellowlegs	Sept. 16–Dec. 31.
Rail, other than coot and gallinule	Sept. 16–Nov. 30.

No open season: Elk, antelope, sheep, quail (bobwhite crested), pheasant (1924); doe, partridge, ptarmigan, wild turkey, dove.

Hunting and fishing licenses: *Nonresident*—Big game, $25; birds, $5; fish, $2. *Resident*—Big game, $2; small game and fish, $1. No person under 18 permitted to hunt big game. Fishing license not required of boys under 16 or of women. Guide, $5 in addition to State hunting license. Issued by commissioner and county clerks. Unlawful to hunt in any inclosure not public land without consent of owner. Unlawful to shoot game from public highway.

Bag limits and possession: One deer a season, coupon required; prairie chicken, sage hen, mountain and willow grouse, 10 in all a day, 15 in possession. Twenty ducks, 8 geese, 8 brant, 20 Wilson snipe, 20 in all of rails, coots, and gallinules, 15 in all of plovers and yellowlegs, but not more than 20 in all of migratory game birds a day, 25 in possession. Persons under 12 years of age limited to half this number of birds. Possession of rails permitted during first 10 days of close season; other game during first 5 days thereof. Commissioner may issue permit authorizing storage, possession, and use of upland game for 90 days after close of open season, and migratory birds for 10 days after close of season.

Sale: Sale of migratory game and of all other game taken in the State prohibited; provided, imported game (except migratory birds) may be sold under license by indorsement of shipping invoice to purchaser.

Export: The export of all protected game is prohibited; provided, birds may be exported under permit from game commissioner (fee 25 cents for each bird) if permit be attached and packages plainly marked so as to show nature of contents, but not more than 2 days' limit of migratory birds shall be exported in any one calendar week.

CONNECTICUT.

Open seasons:

Deer.[1]	
Hare, rabbit (except Belgian or German hare, unprotected)	Oct. 8–Jan. 31.[2]
Gray squirrel, quail, ruffed grouse, pheasant (introduced), Hungarian partridge, woodcock	Oct. 8–Nov. 23.
Duck, goose, brant	Oct. 1–Jan. 15.
Mudhen, gallinule	Oct. 1–Dec. 31.
Black-bellied and golden plovers, yellowlegs	Sept. 1–Nov. 30.
Wilson or English snipe	Oct. 1–Nov. 30.
Rail, other than coot and gallinules	Sept. 12–Nov. 30.

No open season: Dove.

Hunting licenses: Nonresident, $10.25; alien, $15.25; resident citizen, $1.25. Not issued to persons under 16. Issued by city or borough clerk. No license required of resident and his children to hunt during open season on land on which he is actually domiciled, if land is not used for club or shooting purposes.

Bag limits and possession: Six gray squirrels a day, 30 a season; 5 rabbits a day, 35 a season; 5 each of quail, ruffed grouse, pheasant, Hungarian partridge, woodcock a day, 36 a season; 25 in all of ducks, geese, and brant but not exceeding 8 geese and 8 brant a day; 10 in all of plover, yellowlegs, and Wilson snipe, and 25 in all of rails, coot, and gallinules a day. Possession of rails permitted during first 10 days of close season.

Sale: Sale of deer, squirrels, rabbits, and introduced pheasant permitted during open season. Sale of other game prohibited.

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[1] *Connecticut:* Deer may be killed with shotgun on a person's own land at any time if reported to commissioners within 24 hours.

[2] Between Nov. 24 and Jan. 1, hunting rabbits is permitted with dog and ferret only.

Export: Export of quail, ruffed grouse, and woodcock prohibited, provided, a nonresident licensee, under permit, may take out in his immediate possession game lawfully killed, when duly tagged, if not for sale, but not more than 2 days' limit of migratory birds shall be exported in any one calendar week.

DELAWARE.

Open seasons:

Rabbit, hare, quail, partridge, woodcock	Nov. 15—Dec. 31.
Squirrel (fox, black, gray)	Sept. 1—Oct. 15.
Dove (except in Newcastle County, no open season)	Nov. 15—Dec. 15.
Duck, goose, brant, Wilson snipe or jacksnipe, coot, gallinule	Oct. 16—Jan. 31.
Black-bellied and golden plovers, yellowlegs	Aug. 16—Nov. 30.
Rail, other than coot and gallinule	Sept. 1—Nov. 1.

No open season: Hungarian partridge or pheasant, reedbird.

Hunting licenses: Nonresident, $10.50. Issued by commission. Unlawful to hunt on land of another without permission from owner or occupant.

Bag limits and possession: Six in all of rabbits, hares, and squirrels, 20 ducks, 8 geese, 8 brant, 15 in all of plovers and yellowlegs, 25 Wilson snipe, 6 woodcock, 12 in all of birds of any other species a day. Possession of migratory birds permitted during first 10 days of close season; other game during first 5 days thereof.

Sale: Sale of all protected game prohibited: Provided a resident may lawfully sell in his own county game, except migratory birds, lawfully taken by him. Restaurants buying game lawfully sold may serve same during open season. Imported rabbits may be sold from November 15 to December 31.

Export: Export of rabbit, squirrel, quail, partridge, dove, woodcock, goose, and brant is prohibited, provided holder of license may export, open to view, 10 rabbits, 10 squirrels, 50 rails, and 20 birds or fowl of any other species a week, lawfully killed by himself, under affidavit that the game is not for sale. Resident may export ducks, snipe, and plover. In no event, however, shall a person export more than 2 days' limit of migratory birds in any one calendar week. Under permit (fee, $1) of board 10 pairs of any one species of game or birds may be captured or transported.

DISTRICT OF COLUMBIA.[1]

Open seasons:

Deer meat (sale or possession)	Sept. 1—Jan. 1.
Rabbit (except English rabbit, Belgian hare), squirrel	Nov. 1—Feb. 1.
Quail or partridge	Nov. 1—Mar. 15.
Ruffed grouse or pheasant (except English or other imported pheasants raised in inclosures, sale or possession unrestricted), wild turkey	Nov. 1—Dec. 26.
Prairie chicken (pinnated grouse)	Sept. 1—Mar. 15.
Marsh blackbird	Sept. 1—Feb. 1.
Duck, goose, brant, Wilson snipe, coot, gallinule	Nov. 1—Jan. 31.
Black-bellied and golden plover, yellowlegs, rail or ortolan	Sept. 1—Nov. 30.
Woodcock	Nov. 1—Dec. 31.

No open season: Dove and reedbird.

Bag limits and possession: Twenty-five ducks, 8 geese, 8 brant, 25 Wilson snipe, 6 woodcock, 25 in all of rails, coots, and gallinules, 15 in all of plovers and yellowlegs. Possession of migratory birds permitted during first 10 days of close season.

Sale: Sale of migratory game birds prohibited. Other game may be sold during respective open seasons.

Export: Export of migratory game birds in excess of two days' bag limit in any one calendar week prohibited.

FLORIDA.

Open seasons:

Deer, squirrel, quail (bobwhite partridge), wild turkey	Nov. 20–Mar. 1.
Ruffed grouse, imported pheasants	Nov. 20–Dec. 19.
Dove	Nov. 20–Dec. 31.
Duck, goose, brant, black-bellied and golden plovers, Wilson snipe, yellowlegs, coot, gallinules	Nov. 20–Jan. 31.
Woodcock	Nov. 1–Dec. 31.
Rail, other than coot and gallinules	Nov. 20–Nov. 30.

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[1] *District of Columbia:* Hunting prohibited in the District, by act of June 30, 1906, except on the marshes of the Eastern Branch above the Anacostia Bridge and below the Aqueduct Bridge on the Virginia side of the Potomac, but in these areas no birds may be shot within 200 yards of any bridge or dwelling.

No open season: Common ground and scaled doves.

Hunting licenses: Nonresident or alien, $15; resident, $1 (county of residence); resident, $3 (county other than county of residence). License not required in voting precinct nor of Confederate veteran entitled to a State pension. Issued by county judge.

Bag limits and possession: Three deer, 10 turkeys, and 300 of any other game birds a year; 1 deer, 2 turkeys, 20 quail, 25 ducks, 8 geese, 8 brant, 25 Wilson snipe, 6 woodcock, 25 in all of rails, coots, and gallinules, 15 in all of plovers and yellowlegs, and 25 doves a day. Possession of migratory birds permitted during first 10 days of close season; other game during first 5 days thereof.

Sale: The sale of all protected game is prohibited.

Export: Export of all protected game is prohibited, except nonresident licensee may carry out game as personal baggage, but not more than two days' limit of migratory game birds shall be exported in any one calendar week.

GEORGIA.

Open seasons:

Deer	Oct. 1–Nov. 30.
Rabbit, fox squirrel	Unprotected.
Cat squirrel, opossum	Oct. 1–Feb. 28.
Quail, partridge, wild turkey gobblers	Nov. 20–Feb. 28.
Dove	Nov. 20–Dec. 31.
Duck, goose, brant, coot, gallinule, Wilson snipe	Nov. 1–Jan. 31.
Black-bellied and golden plovers, yellowlegs	Nov. 20–Jan. 31.
Woodcock	Nov. 1–Dec.31.
Rail, other than coot and gallinules	Sept. 1–Nov. 30.

No open season: Fawn, grouse, pheasant, turkey hen, introduced game birds, ricebird.

Hunting licenses: Nonresident, $15; resident, State $3, county $1 (good only in county of residence). License not required in militia district or to hunt on own or leased land. Issued by commissioner or county warden.

Bag limits and possession: Two deer, 2 turkeys a season; 15 cat squirrels, 25 ducks, 8 geese, 8 brant, 15 in all of plovers and yellowlegs, 25 Wilson snipe, 6 woodcock, 25 in all of rails, coot, and gallinules, 25 doves a day. Possession of migratory birds except woodcock permitted during first 10 days of close season.

Sale: Sale of all protected game prohibited.

Export: Export of all protected game prohibited, provided, nonresident licensee may take out in personal possession game lawfully killed, but not more than 2 days' limit of migratory birds shall be exported in any one calendar week.

IDAHO.

Open seasons:

Elk in Bingham, Bonneville, Fremont, Teton Counties	Sept. 16–Nov. 30.
In Idaho County	Nov. 1–Nov. 30.
In rest of State	No open season.
Deer in Benewah, Bonner, Boundary, Clearwater, Kootenai, Latah, Lewis, Nez Perce, and Shoshone Counties	Oct. 16–Dec. 31.
In Bannock, Bear Lake, Cassia, Franklin, Fremont, Oneida, Power, Twin Falls Counties, and game preserves	No open season.
In rest of State	Sept. 16–Nov. 30.
Mountain goat in Bannock, Bear Lake, Cassia, Franklin, Oneida, Power, Twin Falls Counties, and game preserves	No open season.
In rest of State	Sept. 16–Nov. 30.
Partridge, pheasant, grouse	Aug. 16–Oct. 31.
Chinese pheasant in Ada, Canyon, Gem, Gooding, and Nez Perce Counties only	Nov. 1–Nov. 10.
Turtle dove	Sept. 1–Sept. 30.
Duck, goose, brant, Wilson snipe, black-bellied and golden plovers, yellowlegs, coot, and gallinules	Sept. 16–Dec. 31.
Rail other than coot and gallinules	Sept. 1–Nov. 30.

No open season: Moose, antelope, caribou, sheep, buffalo, fawn, calf elk, prairie chicken, pinnated grouse, sage hen, and imported pheasants (except Chinese pheasant as above); quail (1920).

Hunting and fishing licenses: Nonresident or alien: Big game, $25; bird, $7.50; fish, $5. Resident: Game and fish, $1. Fishing license not required of children under 12 or of women. No license required of veterans of Civil War. Persons under 12 prohibited possessing gun afield.

Bag limits: One deer, 1 elk, 1 goat a season; 8 quail, 2 Chinese pheasants, 6 in all of partridge, pheasant, grouse, turtle dove, 12 ducks, 2 geese a day or in possession; 6 black-bellied and golden plovers, 6 yellowlegs, 6 Wilson snipe, or a total of 15 in all a day or in possession; 25 in all of rails, coot, and gallinules a day.

Sale: Sale of all protected game prohibited. Hides and heads may be sold under permit.

Export: Export of all protected game is prohibited, provided, any hunter may export, under hunting license coupon, big game lawfully taken; big game once shipped within State may be exported under a 50-cent permit obtained from game warden or deputy. Mounted heads and stuffed birds legally secured may be exported.

ILLINOIS.

Open seasons:

Rabbit	Sept. 1–Jan. 31.
Squirrel	Aug. 1–Jan. 31.
Quail (bobwhite)	Nov. 11–Dec. 9.
Prairie chicken	Oct. 1–Oct. 15.
Introduced pheasant (cocks)	Oct. 1–Oct. 5.
Duck, goose, brant, Wilson snipe, coot, gallinules, black-bellied and golden plovers, yellowlegs	Sept. 16–Dec. 15.

No open season: Deer, wild turkey, introduced pheasant hen, sand grouse (1925); ruffed grouse (partridge), blue, mountain, and valley quail, Hungarian partridge, capercailzie, heath hen, black grouse, woodcock, rail (1920); dove.

Hunting licenses: Nonresident or alien, $10.50. Issued by county clerk. Resident, $1. Issued by city or county clerk. Owners, their children, and tenants in actual residence may hunt during open season on own land without license.

Bag limits and possession: Fifteen squirrels, 12 quail, 3 prairie chickens, 2 cock pheasants, 10 doves, 15 in all of black-bellied and golden plovers and yellowlegs, 15 snipe, 15 in all of coots and gallinules, 15 ducks, 8 geese, 8 brant a day. Limit in possession, 30 squirrels, 36 quail, 12 prairie chickens, 40 doves, 50 black-bellied and golden plovers, snipe, and yellowlegs, 60 coots and gallinules, 60 ducks, 20 geese or brant.

Sale: Sale of all protected game (except rabbit during open season) prohibited.

Export: Export of all protected game (except rabbit) prohibited, except nonresident licensee may take from State 50 birds killed by himself, if carried openly for inspection, but not more than 2 days' limit of migratory birds shall be exported in any one calendar week.

Holder of certificate may ship birds and game at any time for scientific or propagating purposes. (See Regulation 8, p. 63.)

INDIANA.

Open seasons:

Rabbit	Apr. 1–Jan. 10.
Squirrel	Aug. 1–Dec. 1.
Quail, ruffed grouse	Nov. 10–Dec. 20.
Prairie chicken	Oct. 15–Nov. 1.
Duck, goose, brant	Sept. 16–Dec. 31.
Woodcock	Oct. 15–Nov. 1.
Black-bellied and golden plovers, yellowlegs, Wilson or jacksnipe, coot, gallinule	Sept. 16–Dec. 20.
Rail other than coot and gallinules	Sept. 1–Nov. 30.

No open season: Deer, Hungarian partridge, introduced pheasant, wild turkey, dove.

Hunting and fishing licenses: Nonresident, game and fish, $15.50; fish, $1. Resident, $1. Issued by clerk circuit court. Not issued to person under 14 without written consent of parent or guardian. Civil War veterans, owners of farm land, their children living with them, and tenants may hunt during open season on own land without a license. No license required of persons to fish in county of residence or contiguous counties. Wife of licensee and children of licensee under 18 may fish without license.

Bag limits and possession: Fifteen quail, 5 prairie chickens, 15 ducks, 8 geese, 8 brant a day; 45 waterfowl in possession as result of 3 or more days' consecutive hunting; 25 Wilson snipe, 6 woodcock, 25 in all of rails, coots, and gallinules, and 15 in all of plovers and yellowlegs a day. Possession of waterfowl permitted during first 10 days of close season.

Sale: Sale of quail, prairie chickens, introduced pheasants, Hungarian partridges, and migratory birds prohibited.

Export: Export of deer, quail, grouse, prairie chicken, pheasant, wild turkey, woodcock, duck, goose, brant, and other waterfowl prohibited, except nonresident may take from State 15 birds killed by himself (or 45 if he has hunted for 3 or more days consecutively) if carried openly for inspection together with license, but not more than two days' limit of migratory birds shall be exported in any one calendar week.

Miscellaneous: Shooting on highways prohibited.

IOWA.

Open seasons:

Squirrel (gray, timber, or fox)	Sept. 1–Jan. 1.
Ruffed grouse or pheasant, wild turkey	Nov. 1–Dec. 15.
Duck, goose, brant, Wilson snipe or jacksnipe, coot, gallinule, black-bellied and golden plovers, yellowlegs	Sept. 16–Dec. 31.
Woodcock	Oct. 1–Nov. 30.
Rail other than coot and gallinule	Sept. 1–Nov. 30.

No open season: Deer, elk, quail, prairie chicken, introduced pheasants, Hungarian partridge (1922); turtle dove.

Hunting and fishing licenses: Nonresident or alien, game, $10; nonresident, fish, $2 (required of males over 16 years of age). Resident citizen, $1. Issued by county auditor. Licenses not granted to person under 18 without written consent of parent or guardian. Owners of farm lands, their children, and tenants, may hunt on own lands during open season without license. Unlawful to hunt on cultivated or inclosed lands of another without permission from owner.

Bag limits and possession: Twenty-five ducks a day, 50 in possession; 8 geese, 8 brant, 15 in all of plovers and yellowlegs, 25 Wilson snipe, 6 woodcock, 25 in all of rails, coots, and gallinules a day, 25 of each in possession. Twenty-five each of other birds and game a day or in possession. Possession of migratory birds permitted during first 10 days of close season; other game during first 5 days thereof.

Sale: Sale of all protected game prohibited.

Export: Export of all protected game prohibited, except nonresident may take from State not more than 25 game birds or animals, if carried openly for inspection, and if hunting license be shown on request, but not more than two days' limit of migratory birds shall be exported in any one calendar week.

KANSAS.

Open seasons:

Fox squirrel	Sept. 1–Dec. 31.
Quail, prairie chickens, pheasants (English, Mongolian, or Hungarian)	Unprotected.
Duck, goose, brant, Wilson snipe, coot, gallinules, black-bellied and golden plovers, yellowlegs	Sept. 16–Dec. 31.
Woodcock	Oct. 1–Nov. 30.
Rail other than coot and gallinules	Sept. 1–Nov. 30.

No open season: Deer, antelope (1921); red, gray, and black squirrels, grouse, doves.

Hunting licenses: Nonresident, $15. Issued by secretary of state. Resident, $1. Issued by county clerk. Issued free to honorably discharged soldiers or sailors of United States. Resident landowner or member of family may hunt on own land during open season without a license. Unlawful to hunt on land of another or on highway or railroad right of way adjacent thereto without written consent of owner, unless accompanied by him.

Bag limits and possession: Twenty ducks, 12 Wilson snipe, 6 each of woodcock, geese, and brant, 25 in all of rails, coots, and gallinules, and 15 in all of plovers and yellowlegs a day. Possession of migratory birds permitted during first 10 days of closed season.

Sale: Sale of all protected game birds prohibited.

Export: Export of all protected game birds prohibited.

KENTUCKY.

Open seasons:

Rabbit [1]	Nov. 15–Dec. 31.
Squirrel	July 1–Dec. 15.
Quail	Nov. 15–Jan. 1.
Dove	Sept. 1–Oct. 15.
Duck, goose, brant, Wilson snipe or jacksnipe, coot, gallinules, black-bellied and golden plovers, yellowlegs	Sept. 16–Dec. 31.
Rail other than coot and gallinules	Sept. 1–Nov. 30.

No open season: Deer, elk (1921); native and introduced pheasants, Hungarian partridge, wild turkey (1920); woodcock.

Hunting licenses: Nonresident or alien, $7.50. Resident, $1. Issued by county clerk. Resident land owner, tenant, and members of families may hunt on own land during open season without license. Unlawful to enter inclosed lands of another for shooting, hunting, or fishing without consent.

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[1] *Kentucky:* Rabbits may be taken with dogs or snares at any time for a person's own use on own land, but not for sale or barter.

Bag limits and possession: Twelve quail a day, 12 in possession for each day of hunt; 15 doves a day, 15 in possession for each day of hunt; 25 ducks, 8 geese, 8 brant, 15 in all of plovers and yellowlegs, 25 Wilson snipe, 25 in all of rails, coot, and gallinules a day. Possession of migratory birds, except doves, permitted during first 10 days of close season.

Sale: Sale of quail, partridge, grouse, introduced or native pheasant, Hungarian partridge, wild turkey, and migratory birds, wherever killed, prohibited.

Export: Export of deer, elk, and all game birds prohibited, except a hunter may transport game lawfully killed and possessed by him, but more than 2 days' limit of migratory birds shall not be exported in any one calendar week.

LOUISIANA.

Open seasons:

Deer (see exception)	Sept. 15–Jan. 5.[1]
Exception: South of Vernon, Rapides, Avoyelles, and Concordia Parishes, and Mississippi State line	Oct. 1–Jan. 20.
Bear	Nov. 1–Feb. 15.[2]
Squirrel	Sept. 15–Feb. 15.
Dove	Sept. 16–Dec. 31.
Quail	Nov. 15–Feb. 28.
Wild turkey	Nov. 15–Mar. 31.
Duck, goose, brant, black-bellied and golden plovers, Wilson snipe, yellowlegs, rails, coot, gallinules	Nov. 1–Jan. 31.

No open season: Fawns, elk (1919); prairie chicken, introduced pheasant, upland plover (papabotte) (1920); woodcock (1923).

Hunting licenses: Nonresident or alien, $15; resident, $1; market hunting, $10. Issued by tax collectors. Nonresident or alien not permitted to hunt for profit. A person may hunt during open season without a license on land owned or leased for agricultural purposes. License does not authorize hunting on land of another without his written consent.

Bag limits and possession: Two deer a day or in possession, 5 a season; 15 squirrels, 15 quail, 1 turkey, 25 doves, 25 ducks; 8 geese, 8 brant, 10 in all; 25 in all of rails, coots, and gallinules; 15 in all of plovers and yellowlegs; 25 Wilson snipe, and 15 other birds in all a day. Possession permitted during first five days of close season.

Sale: Sale of all protected game (except squirrels during open season) prohibited.

Export: Export of all protected game prohibited, except under permit for scientific or educational purposes; provided, a nonresident licensee may carry with him out of the State under his license one day's limit of game, if not for sale. Bears shall not be exported except under written permission of conservation department.

MAINE.[3]

Open seasons:[4]

Deer (see exception)	Oct. 1–Dec. 15.
Exception: In Androscoggin, Cumberland, Kennebec, Knox, Lincoln, Sagadahoc, Waldo, and York Counties	Nov. 1–Nov. 30.
Hare, rabbit	Oct. 1–Mar. 31.
Gray squirrel	Oct. 1–Oct. 31.
Ruffed grouse, partridge, woodcock	Oct. 1–Nov. 30.
Duck, goose, brant, Wilson snipe, coot, gallinules	Sept. 16–Dec. 31.
Black-bellied and golden plovers, yellowlegs	Aug. 16–Nov. 30.
Rail, other than coot and gallinules	Sept. 1–Nov. 30.

No open season: Deer on Cross, Scotch, and Mount Desert Islands and in towns of Deer Isle and Stonington, in Hancock County and in Isle au Haut in Knox County. Bull moose (1919); cow and calf moose, caribou, quail, Hungarian partridge, pheasant, black game, capercailzie, cock of the woods, dove.

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[1] *Louisiana:* Deer season fixed by conservation commissioner.

[2] Nonresidents coming into State to hunt bears must report in writing to conservation department before arrival at destination.

[3] *Maine:* Commissioners may make local regulations; and governor may suspend hunting seasons during drought.

[4] All hunting is prohibited on Kineo Point, Piscataquis County; on Back Bay above Grand Trunk Railroad bridge, and on Richmonds Island, Cumberland County; southern point Swan Island; and locally in town of Eden, Hancock County, and town of Scarboro, Cumberland County. (See State laws for details and other protected areas.)

Hunting and fishing licenses: Nonresident hunting licenses, October 1–December 31, $15; prior to October 1 in Aroostook, Franklin, Hancock, Oxford, Penobscot, Piscataquis, Somerset, and Washington Counties, $5; season (except November) in rest of State, $5. For November, $15 license required, which may be obtained by holder of $5 license on payment of $10 additional. Nonresident must be accompanied by registered guide when camping and kindling fires on wild lands (land in unorganized townships) while hunting or fishing on wild lands prior to November 30. Nonresident fishing license, $2.15 (not required of children under 14 years of age). Resident alien, game, $15 (not required of aliens who pay taxes on real estate and who have resided in State two years continuously prior to application). Guide licenses: Nonresident, $20; resident, $1. Must not guide more than five persons hunting at one time. Shipping licenses (within State): Resident, deer, $2; one pair of game birds in seven days, 50 cents.

Bag limits and possession: Two deer a season (except in Androscoggin, Cumberland, Kennebec, Knox, Lincoln, Sagadahoc, Waldo, and York Counties, limit 1, and in lumber camps, limit 2); 5 ruffed grouse, 10 ducks, 8 geese, 8 brant, 15 in all of plovers and yellowlegs but not more than 5 plovers, 10 Wilson snipe, 6 woodcock, 25 in all of rails, coot, and gallinules a day. Reasonable time allowed after close of season to transport game to home of owner, but possession of migratory birds limited to first 10 days of close season; deer may be possessed during closed season.

Sale: Sale of migratory birds prohibited; sale of other game birds and deer for export prohibited. Deer may be sold by local dealers under license.

Export: Export of all protected game prohibited, provided a resident of the State may export 1 deer a season if open to view, tagged to show name and address of owner, and accompanied by him, and under shipping license 5 partridges, 10 woodcock, and 10 ducks (fee $5), lawfully killed by himself. A nonresident may export under hunting license tags 2 deer lawfully killed by himself, and may take home 5 partridges, 10 ducks, and 10 woodcock; he may also ship out one pair of game birds a month under a special 50-cent license. Live game may be exported for breeding and scientific purposes under permit of the commissioner of inland fisheries and game.

MARYLAND.

Open seasons:

Rabbit (see exception) .... Nov. 10–Dec. 24.

Exception: In Dorchester, Nov. 10–Jan. 1.

Squirrel (see exceptions) .... Aug. 25–Oct. 1. / Nov. 10–Dec. 24.

Exceptions: In Allegany County .... Sept. 15–Dec. 24.
In Cecil .... Aug. 25–Oct. 25.
In Dorchester .... Sept. 1–Jan. 1.
In Frederick .... Aug. 25–Dec. 24.
In Anne Arundel, Calvert, Charles, Prince George, and Talbot .... Nov. 10–Dec. 24.
In St. Mary .... Unprotected.

Quail, ruffed grouse, wild turkey, introduced pheasant, woodcock (see exceptions) .... Nov. 10–Dec. 24.

Exceptions: Quail in Dorchester, Nov. 10–Jan. 1; quail in Frederick (1921); ring-neck or English pheasant in Baltimore County (1920); ruffed grouse, ring-necked pheasant, wild turkey in Harford (no open season); ruffed grouse, introduced pheasants in Wicomico (1921); introduced pheasants and partridges, ruffed grouse in Dorchester (1920); woodcock in Anne Arundel (no open season).

Dove .... Sept. 1–Dec. 15.
Duck, goose, brant, Wilson snipe, coot, gallinules .... Nov. 1– Jan. 31.[1]
Black-bellied and golden plovers, yellowlegs .... Aug. 16–Nov. 30.[1]
Rail, other than coot and gallinules .... Sept. 1–Nov. 1.

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[1] *Maryland:* Wild fowl shooting restricted locally as follows: On the Susquehanna flats north of a line extending from Turkey Point Lighthouse, Cecil County, and half a mile north of Spesutia Island to Oakington, Harford County, hunting allowed only on Mondays, Wednesdays, and Fridays, Nov. 1–Jan. 1, and Mondays, Wednesdays, Fridays, and Saturdays, Jan. 1–Jan. 31; in Harford County only before 2 p. m.; in Anne Arundel County, on Magothy River on Tuesdays, Thursdays, and Saturdays; on Rhode and West Rivers on Mondays, Wednesdays, and Fridays; on Severn River on Mondays, Wednesdays, and Saturdays; in Cecil County, on Bohemia, Elk, and Sassafras Rivers on Mondays, Wednesdays, Fridays, and Saturdays; in Dorchester County, on Choptank River on Tuesdays, Thursdays, and Saturdays; in Kent County, on Chester River above Cliff City and Spaniard Point on Mondays, Fridays, and Saturdays.

No open seasons: Deer, elk (1922); reedbird.

Hunting licenses: Nonresident, $10.25 (fee $5.25 for State license if applicant owns real estate in Maryland assessed at $500; $1.25 for county license in county where such real estate is located); resident, State, $5.10; county, $1.10; issued by clerks of circuit court—in Baltimore city by clerk court common pleas. License not issued to person under 14 years of age without written request of parent or guardian. Owners, tenants, and their children may hunt on own land during open season without license. Patuxent River Club license, $25; issued by clerk of circuit court. Aliens not permitted to hunt or possess firearms. Unlawful to hunt on lands of another without written permission of owner or tenant.

Sinkbox, sneak boat, blind, pusher.—Cecil: Sneak boat (Bohemia and Elk Rivers), $5.50; sinkbox (Bohemia, Elk, and Sassafras Rivers), $10.50. *Anne Arundel:* Pusher, $2; booby and brush blinds (west side Chesapeake Bay), $5; (South River), $2.50. *Harford:* Sinkbox, $20.75; sneak boat, $5.75. *Kent:* Sinkbox, $20; blind, $5. *Queen Anne:* Sinkbox, $10.50; sneak boat, $5.75; booby blind, $2.50. *Susquehanna Flats:* Sinkbox, $20.75; sneak boat, $5.75. *Talbot:* Sinkbox, $5; blind or sinkbox (Dickson Bay), $5. *Patuxent River:* Pusher, $2.50 (required of residents to push or paddle nonresidents).

Bag limits and possession: Four wild turkeys a season; 10 rabbits, 10 squirrels, 12 quail (partridge), 2 ruffed grouse, 3 English pheasants, 6 woodcock, 12 doves, 10 jacksnipe, 15 yellowlegs, 5 black-bellied plover, 15 golden plover (but not more than 15 plovers and yellowlegs combined), 25 in all of rails, coots, and gallinules (but not more than 10 coots and gallinules), 25 waterfowl (but not more than 8 geese and 8 brant) a day for each licensed gunner (not exceeding 4) connected with an outfit. Possession of waterfowl, Wilson snipe, and plovers permitted during first 10 days of close season, and of doves until December 24.

Additional county restrictions: Allegany, 2 wild turkeys a day. Baltimore, 6 rabbits, 1 jack rabbit, 8 squirrels, 10 quail, 1 English pheasant, 1 ringneck pheasant, 1 wild turkey a day. Calvert, 6 rabbits a day. Cecil, 5 rabbits, 6 squirrels, 50 blackbirds a day. Frederick, 8 rabbits, 5 woodcock a day. Garrett, 2 ruffed grouse, 3 English pheasants, 6 other game birds a day. Harford, 6 rabbits, 1 jack rabbit, 8 squirrels, 10 quail, 5 woodcock, a day or in possession.

Sale: Sale of migratory game birds prohibited. The sale of game is further prohibited under county laws, as follows:

Allegany—Deer, squirrel, hare, quail, grouse, introduced pheasant, wild turkey, dove, woodcock.
Anne Arundel—All game (except squirrel, rabbit, and raccoon).
Baltimore—Rabbit, squirrel, quail, ruffed grouse, dove, pheasant, for export.
Calvert—Rabbit, quail, for export for sale.
Carroll—Squirrel, partridge, pheasant, dove, woodcock.
Cecil—All protected game (except rabbit).
Dorchester—Rabbit, squirrel, quail, partridge, for export.
Frederick—Rabbit, squirrel, partridge, pheasant, taken in county.
Garrett—Partridge, quail, pheasant, wild turkey, for export.
Harford—Rabbit, squirrel, quail (for sale).
Montgomery—Rabbit, quail, partridge, for export.
Somerset—Rabbit, quail or partridge, dead or alive, for any other purpose than as food within the county or for propagation; or any game for export.
Washington—All game.
Wicomico—Quail or partridge for export (Wicomico and Worcester Counties considered as one territory).
Worcester—Rabbit, quail (except to consumer).

Export: Export of all protected game (except waterfowl) prohibited; provided: a licensed hunter may take out under his license an amount equal to one day's bag limit of game, if not for sale.

County provisions prohibiting export are as follows:

Allegany—All protected game (for sale).
Anne Arundel—All protected game, viz: Squirrel, rabbit, quail, partridge, pheasant, woodcock, snipe, plover, duck, goose, brant from county.
Baltimore—Rabbit, squirrel, quail, partridge, pheasant, dove, woodcock from county.
Calvert—Rabbit, partridge, woodcock from county (for sale, barter, or trade).
Carroll—Squirrel, quail, pheasant, dove, woodcock.

Exception: Twelve squirrels, 10 quail, 3 pheasants, 12 doves, 6 woodcock, by guest of landowner or nonresident licensee as personal baggage and not for sale.

Caroline—Rabbit, quail, partridge, woodcock from county.
Cecil—Squirrel, quail, grouse, woodcock, plover from county.

Dorchester—All protected game.

Exceptions: Twelve quail or partridges, 6 each of squirrels, rabbits, woodcock, and doves may be taken out of the county at one time as personal baggage, if carried openly and not intended for sale.

Frederick—Rabbit (for sale), squirrel, partridge, pheasant, woodcock from county (for sale).

Garrett—Partridge, pheasant, wild turkey, woodcock from State.

Exception: Rabbit, if shipped openly, Nov. 10–Dec. 25. Nonresident may take out game killed under his hunting license.

Harford—Rabbit, squirrel, quail.

Exception: Nonresident licensee may take out 6 rabbits, 1 jack rabbit, 8 squirrels, 10 quail, 5 woodcock, 10 jacksnipe, 50 rail for private use.

Kent—Squirrel, rabbit, and all birds from county (for sale, except under license).

Montgomery—Rabbit, partridge, quail, woodcock from county (for sale).

Exception: Nonresident licensee may take out game lawfully killed.

Queen Anne—Rabbit, partridge, woodcock from county (for sale).

Somerset—All game, viz: Squirrel, rabbit, quail or partridge, pheasant, dove, woodcock, duck, goose from county.

Talbot—All game.

Exception: Six rabbits, 6 squirrels, 12 quail, 6 doves, 6 woodcock may be taken out if not for sale.

Washington—Deer, squirrel, rabbit, partridge, pheasant, dove, woodcock, turkey from county (for sale).

Wicomico—Quail or partridge, Wicomico and Worcester Counties considered as one territory.

Worcester—Rabbit, quail, woodcock from county.

MASSACHUSETTS.

Open seasons: [1]

Deer (first Monday in December to the following Saturday, inclusive)	Dec. 2–Dec. 7.
Hare or rabbit (see exceptions)	Nov. 1–Feb. 28.
Exceptions: Hare or white rabbits in Bristol and Norfolk Counties, 1920; European hares in Berkshire County, unprotected.	
Gray squirrel, quail, ruffed grouse or partridge, woodcock (see exceptions)	Nov. 1–Nov. 30.
Exceptions: ***Quail*** in Hampden and Middlesex Counties (1922); in Essex County (1919).	
Woodcock in Berkshire, Franklin, Hampden, and Hampshire	Oct. 20–Nov. 30.
Introduced pheasants (see exception)	Nov. 1–Nov. 30.
Exception: In Barnstable, Dukes, and Nantucket Counties	No open season.
Duck, goose, brant, Wilson snipe, gallinules, quark (mudhen)	Sept. 16–Dec. 31.
Black-bellied and golden plovers, yellowlegs	Aug. 16–Nov. 30.
Rail, other than coot and gallinules	Sept. 1–Nov. 30.

No open season: Moose, dove, prairie chicken, Hungarian partridge, pheasants (English, golden, Mongolian),[2] heath hen, woodcock (1919).

Hunting licenses: Nonresident citizen, $10. Members of incorporated game clubs owning real estate assessed at not less than $1,000 and organized prior to 1907, owners, or their minor children over 18 years old, of real estate assessed at not less than $500, or nonresidents invited (for not more than four days) by members of incorporated club for hunting foxes pay a fee of $1. Resident citizen, $1. Minors under 16 years of age must furnish written consent of parent or guardian. License not required of resident for hunting on own land used exclusively for agricultural purposes and on which he is actually domiciled. Alien, $15 (applicant must own real estate to the assessed value of $500). Issued by city or town clerks.

Bag limits and possession: One deer, 15 gray squirrels, 15 ruffed grouse, 20 woodcock, 20 quail a season; 5 gray squirrels, 3 ruffed grouse, 4 woodcock, 4 quail a day; pheasants, in counties having open season, 2 a day, 6 a season; 25 ducks (not more than 15 black ducks), 8 geese, 8 brant, 15 in all of plovers and yellowlegs, 25 Wilson snipe, 25 in all of rails, coots, and gallinules a day. Possession of waterfowl in counties of Barnstable, Bristol, Dukes, and Nantucket, and of plovers, yellowlegs, and rails permitted during first 10 days of close season.

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[1] *Massachusetts:* Governor may suspend open seasons during extreme drought.

[2] Commission may open season on pheasants.

Sale: The sale of all game (except hare and rabbit) is prohibited, provided, deer, moose, caribou, and elk lawfully killed and imported into the State under warden's tag may be sold under license at any time. Dealers may sell under license unplucked bodies of pheasant, Scotch grouse, European black game, red-legged partridge, and Egyptian or migratory quail imported from without the United States. The above game must be tagged; fee, 5 cents a tag. Hares or rabbits lawfully secured may be sold at any time. Live quail under State permit and waterfowl under Federal and State permits may be sold for propagation.

Export: Export of quail and ruffed grouse taken in State and of all migratory game birds prohibited; provided, a nonresident under his license may take 10 in all of wildfowl, quail, and ruffed grouse into another State according similar privilege, if carried open to view and the commission or district deputy is notified; provided further, a resident may export all game (*except* quail and ruffed grouse) but more than two days' bag limit of migratory birds shall not be exported in any one calendar week. No game illegally taken shall be exported.

Miscellaneous: Deer may be taken with a shotgun only. Unlawful to hunt or kill game with rifle or revolver during open season for deer.

MICHIGAN.

Open seasons: [1]

Deer (see exceptions)	Nov. 10–Nov. 30.
Exceptions: Deer in red coat, fawn in spotted coat; all deer in Bay, Clare, Emmet, Gladwin, Huron, Lake, Midland, Missaukee, Newaygo, Oceana, Ogemaw, Osceola, Otsego, Roscommon, Tuscola Counties (1923).	
Rabbit	Oct. 1–Feb. 1.
Woodcock	Oct. 1–Nov. 9.
Duck, goose, brant, Wilson snipe, coot, gallinule	Sept. 16–Dec. 31.
Black-bellied and golden plovers, yellowlegs	Sept. 16–Dec. 15.

No open season: Elk, moose, caribou, European partridge, dove, rail, squirrel, quail, introduced pheasants, black game, capercailzie, hazel grouse, Canada or spruce grouse, prairie chicken, wild turkey (1920); ruffed grouse (partridge) (1919).

Hunting licenses: [2] Nonresident or alien: Deer, $25; small game, $10. Resident: Deer, $1.50; small game, $1. Issued by county clerks, commissioner, or deputy. Export, issued by commissioner, $10. Licenses issued to persons under 17 and over 12 on application of parent or guardian, who must accompany such minor when hunting. No license required of residents or minor children hunting on own inclosed land on which they reside.

Bag limits and possession: One deer a season, 6 partridge a day, 15 in possession, 25 a season; 25 ducks a day, 50 a calendar week; 6 geese and brant a day, 15 in possession, 25 a season; 6 woodcock a day, 20 in possession, 25 a season; 10 in all of Wilson snipe, black-bellied and golden plovers, and yellowlegs a day, 20 in possession, 25 a season; 25 in all of coot and gallinules a day. Possession of migratory birds permitted during first 10 days of close season; other game during first 5 days thereof. Camping party of six or more licensed hunters may, under permit (fee 50 cents each), kill one deer for camp purposes.

Sale: Sale prohibited of all protected game, except rabbit, provided deer skins and green or mounted buck-deer heads lawfully taken may be sold under permit. Dealers may sell under license unplucked carcasses of pheasants of all species, Scotch grouse, European black game, red-legged partridge, Egyptian quail, European red deer, fallow deer, roe buck, and reindeer lawfully imported from another State or country, if properly tagged on arrival in State. Licensed retail dealer, club, hotel, restaurant, etc., may sell portion of said imported and tagged game to patron or customer for actual consumption or use.

Export: Export prohibited of all protected game.

Exceptions: (1) Deer may be transported outside the State to reach a point within the State.

(2) Nonresident licensee may take out, as hand baggage, open to view, 1 day's bag limit of birds, and may ship one deer when license tag and seal are attached, if permit on back of license coupon is canceled by agent at initial point of billing.

(3) Landowners and members of clubs owning game preserves may take out as hand baggage during open season under a $10 permit from State warden 20 ducks or other

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[1] *Michigan:* Seasons may be shortened or closed by order of commissioner.

[2] *Michigan:* Fishing licenses: Nonresident (males over 21), general, $5; special, $1 (fish, except grayling, salmon, and trout).

migratory birds killed by them on their own premises, but not more than two days' limit of migratory birds shall be exported in any one calendar week.

(4) Deer skins and green or mounted buck-deer heads may be exported under permit.

MINNESOTA.

Open seasons:

Deer, bull moose	Nov. 10–Nov. 30.
Bear, squirrel	Oct. 15–Feb. 28.
Quail, partridge	Nov. 1–Nov. 30.
Sharp-tailed or white-breasted grouse, prairie chicken (pinnated grouse), Wilson snipe or jacksnipe, yellowlegs	Sept. 16–Sept. 30.
Duck, goose, brant, coot, gallinules, rails	Sept. 16–Nov. 30.

No open season: Elk, cow moose, caribou, imported pheasants, woodcock, golden plover, dove, ruffed grouse (1920).

Hunting and fishing licenses: Nonresident: Animals, $25; birds, $10; issued by commissioner. Fishing license, $1; issued by commissioner, county auditors, game wardens, and summer resorts. Alien not permitted to hunt or possess firearms. Resident: Animals, $1; birds, $1. Issued by county auditor. Residents under 14, owners, lessees, or members of their immediate families may hunt without license during open season on own or leased land occupied by them as permanent residence. Unlawful to enter growing grain fields for purpose of hunting.

Bag limits and possession: One deer or 1 antlered moose, 25 prairie chickens a season; 15 ducks a day, 45 in possession; 10 quail a day, 20 in possession, 30 a season; 5 other birds a day, 30 in posssession. Possession permitted during first 5 days of closed season. Under permit, deer and moose may be posssessed to January 31, migratory birds for 10 days after close of season, and other game birds to December 31.

Sale: Sale of all protected game prohibited.

Export: Export of all protected game prohibited, except nonresident licensee may ship home in open season under his license coupons 1 deer, or 1 bull moose, and 25 birds lawfully taken by himself, but not more than 2 days' limit of migratory birds shall be exported in any one calendar week. Deer and moose hides for tanning and heads for mounting may be exported when tagged with license coupons.

MISSISSIPPI.

Open seasons:[1]

Deer (male), bear	Nov. 15–Mar. 1.
Rabbit, squirrel	Unprotected.
Quail or partridge	Nov. 1–Mar. 1.
Wild turkey gobblers	Jan. 1–May 1.
Dove	Sept. 16–Dec. 31.
Waterfowl, Wilson snipe or jacksnipe, coot, poule d'eau, gallinule, black-bellied and golden plovers, yellowlegs	Nov. 1–Jan. 31.
Woodcock	Nov. 1–Dec. 31.
Rail other than coot and gallinule	Sept. 1–Nov. 30.

No open season: Does; turkey hens (1921); woodcock (1919).

Hunting licenses: Nonresident, $20 (county license). Issued by sheriff. Landowners and their nonresident relatives and friends may hunt without license during open season on own lands.

Bag limits and possession: One deer a day, 5 a season; 20 ducks, 8 geese, 8 brant, 15 in all of plovers and yellowlegs, 25 Wilson snipe, 6 woodcock, 20 doves, 15 in all of rails, coot, and gallinules, but a mixed bag shall not exceed 20 birds. Possession of migratory birds permitted during first 10 days of close season.

Sale: Sale of all protected game prohibited.

Export: Export of all protected game prohibited.

MISSOURI.

Open seasons:

Deer (buck), wild turkey	Nov. 1–Dec. 31.
Squirrel	June 1–Dec. 31.
Quail (bobwhite partridge)	Nov. 10–Dec. 31.
Dove	Sept. 1–Nov. 10.
Duck, goose, brant, Wilson snipe, coot, gallinules, black-bellied and golden plovers, yellowlegs	Sept. 16–Dec. 31.
Rail, other than coot and gallinules	Sept. 15–Nov. 30.

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[1] *Mississippi:* Local regulations of boards of supervisors may also be in force, if not inconsistent with above provisions relating to migratory birds.

No open season: Does, fawns under 1 year of age, ruffed grouse (pheasant), prairie chicken (pinnated grouse), woodcock, imported pheasants, other introduced game birds.

Hunting licenses: Nonresident, $25. Issued by commissioner. Resident, State, $5; county, $1, good in county of residence or adjoining county. Issued by county clerk or license collector. Owners and tenants of agricultural lands and members of family under 21 may hunt without license during open season on own or leased land. Hunting on land of another prohibited without his consent.

Bag limits and possession: One deer, 2 turkeys, 10 quail, 15 doves, 15 ducks, 8 geese, 8 brant, 15 in all of plovers and yellowlegs, 25 Wilson snipe a day; 15 rails, 15 coots, 15 gallinules but not more than 25 in all a day or in possession; or 2 deer, 4 turkeys, 15 quail, 25 of any other species of birds in possession. Possession of migratory birds except doves permitted during first 10 days of close season; other game during first 5 days thereof.

Sale: Sale of all protected game prohibited.

Export: Export of all protected game prohibited, except game may be exported under resident or nonresident license if carried openly as baggage or express or in owner's possession and accompanied by him, but more than 2 days' limit of migratory birds shall not be exported in any one calendar week. Export (except of quail) for scientific or propagating purposes allowed under permit.

MONTANA.

Open seasons:

Deer (see exception)	Oct. 1–Nov. 30.
Exception: Deer in Custer, Dawson, Richland, Rosebud, and Yellowstone Counties	Oct. 1, 1922.
Elk in Flathead, Lincoln, Phillips, Teton, and parts of Missoula and Powell Counties	Oct. 1–Nov. 30.
In Carbon, Gallatin, Madison, Park, Stillwater, and Sweetgrass Counties and parts of Beaverhead County	Oct. 1–Dec. 14.
Pheasant, partridge, prairie chicken, sage hen, fool hen, grouse	Sept. 15–Sept. 30.
Duck, goose, brant	Sept. 16–Nov. 30.
Black-bellied and golden plovers, Wilson snipe or jacksnipe, yellowlegs, coot, gallinules	Sept. 16–Dec. 31.
Rail other than coot and gallinules	Sept. 1–Nov. 30.

No open season: Sheep, goat (1922), elk (except as above), moose, caribou, antelope, bison or buffalo, quail, introduced pheasant, dove.

Hunting and fishing licenses: Nonresident: General, $50; birds and fish, $15; fish, $3. Alien: General, $50; fish, $5. Resident: General, $1.50. Guide (resident), $10. Shipping (export), 50 cents. Issued by warden or deputy. Elk (special), $25 (2 elk in Park and Gallatin Counties). Issued by warden.

No license required of female under 18 or of male under 14. Alien not holding a hunting license required to obtain from warden $25 license to possess firearms.

Bag limits and possession: One deer, 1 elk a season except in Gallatin and Park counties where 2 elk may be taken under special $25 license, 5 in all of grouse, partridges, prairie chickens, fool hens, pheasants, and sage hens a day or in possession; 20 ducks a day or in possession; 8 geese, 8 brant, 15 in all of plovers and yellowlegs, 25 Wilson snipe, 25 in all of rails, coot, and gallinules a day. Possession of migratory birds except waterfowl permitted during first 10 days of close season.

Sale: Sale of all protected game prohibited, provided merchant or hotel or restaurant keeper may sell game, except migratory birds, killed outside the State.

Export: Export of all protected game prohibited; provided game lawfully killed may be exported in open season as baggage or express if accompanied by owner and shipping permit from State warden, or under nonresident's hunting license; total shipments under one license shall not exceed season's bag limit, and not more than 2 days' limit of migratory birds shall be exported in any one calendar week; packages to be labeled to show contents.

NEBRASKA.

Open seasons:

Squirrel (gray, red, fox, timber)	Oct. 1–Nov. 30.
Prairie chicken, sage chicken, grouse	Sept. 15–Nov. 15.
Duck, goose, brant, Wilson snipe or jacksnipe, coot, gallinules	Sept. 16–Dec. 31.
Yellowlegs	Sept. 16–Dec. 15.
Rails, other than coot and gallinules	Sept. 1–Nov. 30.

No open season: Deer, elk, antelope, quail, partridge, pheasant, ptarmigan, introduced game birds, dove, wild turkey, plovers, woodcock.

Hunting and fishing licenses: Nonresidents: General, $10; fish, $2. Resident, $1. Issued by commissioner or county clerk. Owner or lessee may hunt and fish without license during open season on lands on which he resides. No license required by male under 18 if accompanied by parent or guardian; male under 18 and female may fish without license. Hunting on land of another without permission or from highways prohibited.

Bag limits and possession: Ten each of squirrels, quail, prairie chickens, and grouse, 25 ducks a day; 8 geese, 8 brant a day, 10 in all in possession; 25 Wilson snipe, 15 in all of plovers and yellowlegs, 25 in all of rails, coots, and gallinules a day; 20 squirrels, 10 prairie chickens or grouse, 10 wild geese or brant, or 50 in all of other game birds in possession. Possession permitted during first 5 days of close season.

Sale: Sale of all protected game prohibited.

Export: Export of all protected game prohibited, except nonresident may ship 50 birds out of State under hunting license, but must give common carrier invoice of number and kind of birds, must have details of shipment marked on license, and must accompany the shipment, but more than 2 days' limit of migratory birds shall not be exported in any one calendar week; package to be labeled to show contents.

NEVADA.

Open seasons: [1]

Deer	Oct. 15–Nov. 15.
Prairie chicken	Oct. 1–Jan. 15.
Sage hen	July 15–Sept. 1.
Mourning and white-winged doves	Sept. 1–Dec. 15.[1]
Duck, goose, brant, coot, gallinules, Wilson snipe or jacksnipe, black-bellied and golden plovers, yellowlegs	Sept. 16–Dec. 31.
Rails, other than coot and gallinules	Sept. 1–Nov. 30.

No open season: Elk, antelope, sheep, goat (1930); pheasants (1920); mountain quail, grouse (1922).

Hunting and fishing licenses: Nonresident: Game, $5; fish, $5. Alien: Fish, $15. Resident citizen: Game, $1, fish, $1. Issued by county clerks and wardens. Aliens prohibited from hunting. No license required of boys under 14 and women. Landowners may hunt and fish on own land without license during open season.

Bag limits and possession: One deer a season; 10 sage hens, 20 ducks, 5 geese, 5 brant, 15 snipe a day or in possession; 15 in all of plovers and yellowlegs, 25 in all of rails, coots, and gallinules, and 25 doves a day. Possession of migratory birds permitted during first 10 days of close season.

Sale: Sale of all protected game prohibited.

Export: Export of all protected game prohibited.

NEW HAMPSHIRE.

Open seasons: [2]

Deer in Coos County	Oct. 15–Dec. 15.
In Carroll (except town of Moultonborough) and Grafton Counties	Nov. 1–Dec. 15.
In town of Moultonborough and counties of Belknap, Merrimack, and Strafford	Nov. 15–Dec. 15.
In Cheshire, Rockingham, and Sullivan Counties	Dec. 1–Dec. 15.
In Hillsborough County	Dec. 15–Dec. 31.
Hare, rabbit	Oct. 1–Feb. 28.
Quail, partridge, ruffed grouse, woodcock	Oct. 1–Nov. 30.
Duck, goose, brant, Wilson snipe or jacksnipe, coot, gallinules	Sept. 16–Dec. 31.
Black-bellied and golden plovers, yellowlegs	Aug. 16–Nov. 30.
Rails, other than coot and gallinules	Sept. 1–Nov. 30.

No open season: Elk, moose, caribou, dove, pheasant, European partridge; gray squirrel (1919).

Hunting and fishing licenses: Nonresident: Game and fish, $15; fish, $1. Resident: game and fish, $1. Issued by commissioner or his agent in each town who with few exceptions is the town clerk. Licenses not granted to children under 13 years of age, and only with written consent of parent or guardian to minors under 16 years. Child under 13 may hunt without license when accompanied by licensed parent or guardian. Resident owner of farm lands and minor children may hunt during open season on own land without license. Guide: Nonresident, $20; resident, $1. Issued by commissioner.

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[1] *Nevada:* County commissioners may shorten open seasons on game and with approval of State warden may fix seasons on valley quail and may shorten season on doves.

[2] *New Hampshire:* Governor and council may suspend open season in time of excessive drought.

Bag limits and possession: Two deer a season in Coos, Carroll, and Grafton Counties or 1 in rest of State; 5 hares, 5 quail a day; 10 ruffed grouse a day, 50 a season; 6 woodcock a day, 50 a season; 20 ducks, 8 geese, 8 brant, 25 Wilson snipe, 15 in all of plovers and yellowlegs, 25 in all of rails, coots, and gallinules a day. Deer may be possessed for a reasonable time after close of open season.

Sale: Sale of all migratory birds prohibited. Sale for food purposes prohibited of the dead bodies of birds belonging to a family any species or subspecies of which is native to and protected by the State; provided, deer, hares, and rabbits may be sold during the open season.

Export: Export of all protected game prohibited; provided game (except ruffed grouse) imported from without the United States or raised in private preserves, when tagged and marked to show kind and number, name and address of consignor and consignee, and initial point of billing and destination, may be exported unaccompanied by the owner, but not more than 2 days' limit of migratory birds shall be exported in any one calendar week. Game for propagation, the head, hide, feet, or fur of game quadrupeds, and the plumage or skin of game birds (except migratory birds) legally taken and possessed may be transported without being marked. Nonresident may take with him out of the State, under his hunting license and permit, one day's limit of game birds when properly marked and tagged, and 2 deer under license tags.

NEW JERSEY.

Open seasons:

Deer[1] (male, with horns visible above the hair)	Oct. 16, 23, 30, and Nov. 6.
Rabbit, squirrel, quail, ruffed grouse (partridge), prairie chicken, Hungarian partridge, English or ringneck pheasant cocks	Nov. 10–Dec. 15.
Duck, goose, brant, coot, gallinules	Oct. 16–Jan. 31.
Black-bellied and golden plovers, yellowlegs	Aug. 16–Nov. 30.
Wilson snipe or jacksnipe	Oct. 16–Dec. 31.
Woodcock	Oct. 10–Nov. 30.
Rails (marsh hens) other than coot and gallinules	Sept. 1–Nov. 30.

No open season: Does and fawns; English or ringneck pheasant hens, wild turkey (1919); dove, reedbird.

Hunting and fishing licenses: Nonresident: Game and fish, $10.15; fish, $2.15. Resident male citizen above age of 14: Game and fish, $1.15. When applied for by parent or legal guardian, in discretion of commission, license may be granted to citizen between the ages 10 and 14 to hunt when accompanied by adult holder of a general license; fee, $1; issued only by commission. All other licenses issued by county, city, or town clerk, salaried warden, or registrar of licenses.

Unnaturalized foreign-born person prohibited from hunting or owning shotgun or rifle unless he is the owner of real property in New Jersey to the value of $2,000 above all improvements.

Bag limits and possession: One deer a season, 10 rabbits, 10 quail, 3 ruffed grouse, 3 English or ringneck pheasants, 3 Hungarian partridges, 6 woodcock, 20 ducks, 8 each of geese and brant a day; possession limited to 10 woodcock, 20 ducks, and 10 each of geese and brant. Twenty-five snipe, 15 in all of plovers and yellowlegs, 25 in all of rails, coots, and gallinules a day, 30 rails (marsh hens) in possession. Possession of migratory birds except Wilson snipe permitted during first 10 days of close season.

Sale: The sale of deer, squirrel, all migratory birds, and any other game birds belonging to a family any species of which is native to and protected by the State is prohibited; provided rabbits may be sold during open season and 15 days thereafter; certain imported game, also deer and pheasants, may be sold at all times of the year if properly tagged.

Export: Export of hare, rabbit, squirrel, woodcock, waterfowl, and all other protected upland game birds is prohibited, except nonresident licensee may carry openly from the State 10 rabbits, 50 rail, and 15 other game birds a day, but not more than 2 days' limit of migratory birds shall be exported in any one calendar week.

Miscellaneous: Unlawful to use shotgun or rifle holding more than two cartridges or that may be fired more than twice without reloading.

NEW MEXICO.

Open seasons:

Deer (with horn):	
North of latitude 35°	Oct. 16–Nov. 5.
South of latitude 35°	Oct. 25–Nov. 25.
Squirrel (tassel-eared gray)	June 1–Nov. 30.

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[1] *New Jersey:* Wild deer may be taken only with shotgun not smaller than 12 gauge.

Quail (except bobwhite)	Oct. 25–Dec. 31.
Grouse	Sept. 16–Nov. 25.
Wild turkey:	
North of latitude 35°	Nov. 1–Dec. 31.
South of latitude 35°	Oct. 25–Nov. 25.
Turtle dove and white-winged dove	Sept. 1–Sept. 30.
Duck, goose, brant, Wilson snipe, coot, gallinules	Oct. 16–Jan. 31.
Black-bellied and golden plovers, yellowlegs	Sept. 1–Dec. 15.
Rails other than coot and gallinules	Sept. 1–Nov. 30.

No open season: Does, Sonoran deer, elk, sheep, goat, antelope, buffalo, bobwhite quail, pheasant, ptarmigan, prairie chicken, sage hen (1920).

Hunting and fishing licenses: Nonresident: Big game, bird, and fish, $30; big game and bird, $25; bird, $10; fish, $5. Alien nonresident: Big game, bird, and fish, $55; big game and birds, $25. Resident: Big game, bird and fish, $2; big game and bird, $1.50; big game, $1; bird, $1; fish, $1. Guide, $5; duplicate, $1. Issued by county clerks and deputies designated by State warden.

Bag limits and possession: One deer a season, 3 wild turkeys, 5 grouse, 20 quail, 20 doves, 20 ducks a day or in possession; 8 geese, 8 brant, 25 Wilson snipe, 15 in all of plovers and yellowlegs, 25 in all of rails, coots, and gallinules. Possession permitted during open season and first 5 days of close season. Under permit, game, except migratory birds, may be held in storage for first 30 days of close season; migratory birds may be so held for a period of 10 days.

Sale: Sale of all protected game taken in the State prohibited; *provided,* game (except migratory birds) imported into State by hotel, restaurant, café, boarding-house keeper, or dealer may be sold under a permit good for not more than 30 days.

Export: Export of all game taken in the State prohibited, except under permit, fee $1 ($2 in case of export of deer); holder of hunting license, under permit from warden, may export game or birds for scientific or propagating purposes.

NEW YORK.

Open seasons: [1]

Deer (with horns not less than 3 inches long) in Adirondack region [2] (see exceptions)		Oct. 1–Nov. 15.
Exceptions: In Ulster County and towns of Neversink, Cochecton, Tusten, Highland, Lumberland, Forestburg, Bethel, and all of towns of Mamakating and Thompson south of Newburgh and Cochecton turnpike in Sullivan County, and Deer Park, in Orange County	Nov. 1–Nov. 15.	
On own land in Columbia, Dutchess, and Rensselaer Counties with shotguns only	Oct. 1–Nov. 15.	
Varying hare, rabbit [3]		Oct. 1–Jan. 31.
Squirrel, black, gray, or fox (no open season in corporate limits of city or village)		Oct. 1–Nov. 15.
Grouse, partridge [3]		Oct. 1–Oct. 31.
Pheasant, male only [3] (four days only)		Oct. 24 and 31. Nov. 2 and 9.
Waterfowl, coot, gallinules		Sept. 16–Dec. 31.
Black-bellied and golden plovers, snipe, yellowlegs, rails		Sept. 16–Nov. 30.
Woodcock		Oct. 1–Nov. 15.

No open season: Elk, moose, caribou, antelope, female deer and fawns, Hungarian or European gray-legged partridge, dove, and quail (1920).

Hunting licenses: [4] Nonresident or alien, $10.50; resident, $1.10. Issued by county, city, and town clerks. Owner, members of immediate family, and tenants actually occupying cultivated farm land may hunt thereon without license during open season. Licensee required to wear button.

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[1] *New York:* When date of open or close season falls on Sunday, season opens, except on migratory birds, or closes on the preceding Saturday.

[2] The Adirondack region comprises the counties of Clinton, Essex, Franklin, Fulton, Hamilton, Herkimer, Jefferson, Lewis, Oneida, Oswego, Saratoga, St. Lawrence, Warren, and Washington.

[3] Commission may shorten open seasons on game. Open season on upland game fixed or closed by order of commission as follows: *Cotton-tail rabbit* in Richmond County, Oct. 1–Nov. 14 and Jan. 1–Jan. 31. *Pheasants* in Sullivan, Oct. 1, 1919.

[4] Nonresident fishing license fee, $2.50. Issued by county, city, and town clerks. Not required of person under 16 years of age or in international boundary waters if residents require no license in that part of those waters not within jurisdiction of State.

Bag limits: Two deer, 20 woodcock, 20 grouse, 3 male introduced pheasants a season; 6 varying hares or rabbits, 5 squirrels, 4 woodcock, 4 grouse, 25 in all of ducks, geese, and brant (limit for one boat or battery, 40), 15 in all of rails, coots, mud hens and gallinules (limit for one blind, 20), 15 in all of Wilson snipe, plovers, and yellowlegs (limit for one blind, 25) a day.

Possession: *Waterfowl,* September 16–January 10; *deer, grouse, pheasant, woodcock, plovers, snipe,* and *yellowlegs,* during open season and 5 days thereafter. Deer properly tagged may be possessed under $1 permit to February 1.

Sale: Sale of all game birds prohibited; provided, varying hares and rabbits legally taken in State during open season (from without State at any time), and unplucked carcasses of pheasants, Scotch grouse, European gray-legged partridge, European black game, red-legged partridge, and Egyptian quail, and carcasses of European red deer, fallow deer, roebuck, and reindeer imported from without the United States may be sold under license at any time when duly tagged.

Licensed breeders in States having laws similar to the game breeding law of New York may import for sale, under $5 license and cost of inspection, domesticated American elk, white-tailed deer, European red deer, fallow deer, roebuck, pheasants, and mallard and black ducks, when duly tagged.

Head, hide, and feet of quadrupeds legally taken and possessed may be sold at any time.

Export: Export of game and birds prohibited, except any person may export 1 deer and one day's bag limit of other game in one day during open season by means other than common carrier or parcel post. The taker may export in one day by common carrier, except parcel post, one day's limit when accompanied by permit which shall show contents of package. Head, hide, and feet of animals and plumage or skin of game birds legally taken may be exported at any time.

Miscellaneous: Hunting prohibited on lands supplying any municipality with water or on public highways, except public highways within forest preserve counties.

NEW YORK—Long Island.

Open seasons:

Varying hare, rabbit, squirrel (black, gray, fox), quail, pheasants (males only)	Nov. 1–Dec. 31.
Ruffed grouse	Nov. 1–Nov. 30.
Waterfowl	Oct. 16–Jan. 15.
Coot, mud hen, gallinules	Oct. 16–Dec. 31.
Black-bellied and golden plovers, yellowlegs	Aug. 16–Nov. 30.
Wilson snipe or jacksnipe	Oct. 16–Nov. 30.
Woodcock	Oct. 15–Nov. 30.
Rails, other than coot and gallinules	Sept. 16–Nov. 30.

No open season: Deer and dove.

Bag limits and possession: Forty quail, 15 ruffed grouse, 30 male pheasants a season; 6 quail, 2 ruffed grouse, 4 male pheasants a day. For other bag limits see New York.

Hunting licenses, sale export, miscellaneous: (See New York.)

NORTH CAROLINA.[1]

Open seasons: [1]

Dove	Sept. 16–Dec. 31.
Duck, goose, brant, Wilson snipe or jacksnipe, coot, gallinules	Nov. 1–Jan. 31.
Black-bellied and golden plovers, yellowlegs	Sept. 1–Dec. 15.
Woodcock	Nov. 1–Dec. 31.
Rails other than coot and gallinules	Sept. 1–Nov. 30.

No open season: Reedbird (ricebird).

Bag limits and possession: Twenty-five doves, 25 ducks, 8 geese, 8 brant, 6 woodcock, 25 Wilson snipe, 15 in all of plovers and yellowlegs, 25 rails, coots, and gallinules a day. Possession of migratory birds permitted during first 10 days of close season.

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[1] *North Carolina:* Only the Federal seasons and other restrictions on migratory birds are given. County seasons and provisions relating to licenses, bag limits, sale, and export are too numerous to be included. Full information regarding county laws may be had on application to the secretary, Audubon Society, Raleigh, N. C. The county laws should be consulted, as in some instances they prohibit the hunting of migratory game birds during part of the periods mentioned in the table. Wood duck, swans, robins, larks, and certain other migratory birds must not be killed at any time. (See Migratory Bird Regulations, pp. 60–61.

Sale: Sale of migratory birds prohibited.

Export: The export is prohibited of quail, partridge, pheasant, grouse, wild turkey, snipe, shore or beach birds, woodcock, taken in State.

Exceptions: Nonresident may take out of State under his hunting license 50 quail (partridges), 12 grouse, 2 turkeys, and 50 in all of Wilson snipe, plovers, and yellowlegs in a season, but not more than two days' limit of migratory birds shall be exported in any one calendar week. Export permitted under permit of Audubon Society of ruffed grouse, wild turkey, woodcock, snipe, and other shorebirds for propagation.

NORTH DAKOTA.

Open seasons:

Prairie chicken (pinnated grouse), sharp-tailed (white-breasted) grouse, black-bellied and golden plovers, yellowlegs, Wilson snipe	Sept. 16–Oct. 16.
Ruffed grouse in Bottineau, Cavalier, Pembina, and Roulette Counties only	Oct. 1–Oct. 10.
Duck, goose, brant	Sept. 16–Dec. 1.
Coot, gallinules	Sept. 16–Dec. 31.
Woodcock	Oct. 1–Oct. 16.
Rails other than coot and gallinules	Sept. 1–Nov. 30.

No open season: (Deer 1920) ; elk, moose, antelope, quail, ruffed grouse (except as above), English and Chinese ringneck pheasants, Hungarian partridge, dove, woodcock.

Hunting licenses: Nonresident, $25; resident, $1. Issued by commissioners, deputy, or county auditor. Aliens not permitted to hunt. Person or member of family permanently residing with him may hunt without license during open season on own lands or lands cultivated by him. Resident license may be issued to settler. No person permitted to enter cultivated or posted lands without consent of owner.

Bag limits and possession: Five prairie chickens, sharp-tailed grouse, plovers, each or all combined a day, 10 each or all in possession at one time, 15 in all of plovers and yellowlegs, but not more than 5 plovers a day; 5 ruffed grouse a day, 15 in possession; 15 snipe, woodcock, rails, ducks, geese, each or all combined a day, but not more than 8 geese, 8 brant, or 6 woodcock; 30 in possession; 25 in all of rails, coots, and gallinules a day. Resident licensee under permit may retain not to exceed 20 pinnated or sharp-tailed grouse, 30 waterfowl, but not more than 50 birds in all during first 5 days of close season.

Sale: Sale of all protected game prohibited, except hides, heads, and trophies of big game lawfully taken may be sold at any time.

Export: Export of all protected game prohibited, except nonresident licensee may carry with him from State under license tag prairie chickens and sharp-tailed grouse not exceeding 20 in all, and ducks, geese, and brant not exceeding 30 in all, or a total of 50 of all birds combined, if open to view and labeled with his name and address and number of his license. Not more than 2 days' limit of migratory birds shall be exported in any one calendar week. Board may grant permits for the export of live game.

OHIO.

Open seasons:

Rabbit	Nov. 15–Jan. 1.
Squirrel	Sept. 15–Oct. 20.
Ruffed grouse, introduced pheasant, Hungarian partridge	Nov. 15–Dec. 4.
Duck, goose, brant, Wilson snipe, black-bellied and golden plovers, yellowlegs	Sept. 16–Dec. 15.[1]
Coot, gallinules	Sept. 16–Nov. 30.
Woodcock	Oct. 1–Nov. 30.
Rails other than coot and gallinules	Sept. 1–Nov. 30.

No open season: Quail, dove.

Hunting licenses: Nonresident citizen, $15.25; resident citizen, $1.25. Issued by county and township clerks. Person under 16 when hunting must be accompanied by adult. Owner, tenant, or their children may hunt without license during open season on own or leased lands. Badge must be worn by hunter. Written permission required on land of another.

Bag limits: Five squirrels, 10 rabbits, 12 each of plovers and yellowlegs, 15 in all, 12 snipe, 6 woodcock, 8 geese, 25 ducks; 25 in all of rails, coots, and gallinules, but not more than 12 rails a day.

Sale: Sale prohibited of all protected game (except rabbit).

Export: Export prohibited of all protected game (except rabbit) taken in State, provided, a nonresident may take with him from State under his hunting license 25 pieces of game, but not more than 2 days' limit of migratory birds shall be exported by one person in any one calendar week. Packages containing game must be marked to show contents.

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[1] *Ohio:* Sundays and Mondays are close seasons for ducks and other waterfowl.

OKLAHOMA.

Open seasons:[1]

Quail	Dec. 1–Dec. 31.
Duck, goose, brant, Wilson snipe or jacksnipe, coot, gallinules	Oct. 16–Jan. 31.
Black-bellied and golden plovers, yellowlegs, dove	Sept. 1–Dec. 15.
Woodcock	Nov. 1–Dec. 31.
Rails, other than coot and gallinules	Sept. 1–Nov. 30.

No open season: Deer (1922), antelope, prairie chicken, imported pheasant, wild turkey.

Hunting licenses: Nonresident, $15; alien, $25; resident citizen, $1.25. Issued by warden, deputy, or county clerk. A person may hunt without license during open season on own or leased premises actually occupied by him. Application of person under 14 must be approved in writing by parent or guardian. Unlawful to shoot on or across highway or railroad right of way. Unlawful to hunt on lands of another without owner's permission.

Bag limits: Fifteen quail, plover, snipe, or ducks, a day, 100 a season; 15 yellowlegs, but not more than 15 in all of plovers and yellowlegs a day; 8 geese, 8 brant a day, but not more than 10 in all a day; 25 in all of rails, coots, and gallinules and 6 woodcock a day. Possession of migratory birds permitted during first 10 days of close season.

Sale: Sale prohibited of all protected game, except the heads, hides, and horns of big game, lawfully killed, may be sold.

Export: Export prohibited of all protected game, except nonresident licensee may carry to his home two days' bag limit of game birds, if license permit is attached.

OREGON.[2]

Open seasons:

District No. 1,[3] *west of Cascades:*	
Deer (male, with horns)	Aug. 15–Oct. 15.
Silver-gray squirrel, dove	Sept. 1–Oct. 31.
Quail in Coos, Curry, Jackson, and Josephine Counties only	Oct. 1–Oct. 31.
Grouse, male Chinese pheasant (see exceptions)	Oct. 1–Oct. 31.
Exceptions: Grouse and male Chinese pheasant in Jackson County	Oct. 1–Oct. 10
Chinese pheasants in Coos, Curry, and Josephine Counties	No open season.
Duck, goose, brant, Wilson snipe, coot, black-bellied and golden plovers, yellowlegs	Oct. 1–Jan. 15.
Rails, other than coot	Oct. 1–Nov. 30.
District No. 2,[3] *east of Cascades:*	
Deer (male, with horns) (see exception)	Sept. 1–Oct. 31.
Exception: In Harney and Malheur Counties	Aug. 15–Oct. 15.
Male Chinese pheasants in Union County only and quail in Klamath County only	Oct. 1–Oct. 10.
Ruffed grouse, native pheasant, blue or sooty grouse	Aug. 15–Oct. 31.
Prairie chicken in Sherman, Union, and Wasco Counties only	Oct. 1–Oct. 15.
Sage hen (see exception)	Aug. 1–Aug. 31.
Exception: In Harney and Malheur Counties	Aug. 1–Sept. 15.
Dove (see exception)	Sept. 1–Oct. 31.
Exception: In Harney and Malheur Counties	Sept. 1–Sept. 30.
Duck, goose,[4] Wilson snipe or jacksnipe, black-bellied and golden plovers, yellowlegs, coot, gallinules (see exception)	Oct. 1–Dec. 31.
Exception: In Grant, Harney, Lake, and Malheur counties	Sept. 16–Dec. 31.
Rails, other than coot	Oct. 1–Nov. 30.

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[1] *Oklahoma:* Bear in Blaine, Caddo, Comanche, Kiowa, and Major Counties, no open season; in balance of State, unprotected.

[2] *Oregon:* Governor may suspend open season in time of drought.

[3] District No. 1, west of Cascades, includes Benton, Clackamas, Clatsop, Columbia, Coos, Curry, Douglas, Jackson, Josephine, Lane, Lincoln, Linn, Marion, Multnomah, Polk, Tillamook, Washington, and Yamhill Counties. District No. 2, east of Cascades, includes all other counties in the State.

[4] Unlawful to kill geese at any time on islands or sand bars in the Columbia east of the Cascades or on Deschutes and John Day Rivers south to junction with White River and Thirtymile Creek, respectively.

No open season: Doe and spotted fawn, moose, elk, antelope, caribou, sheep, goat, Hungarian partridge, bobwhite, prairie chicken, Franklin grouse, fool hen, wild turkey, silver-gray squirrel, quail, and introduced pheasants (except as above).

Hunting and fishing licenses: Nonresident, all game, $10; alien, gun license fee $25 (in addition to hunting and angling license); issued by commissioners; resident, all game, $1.50. Angling, resident or nonresident, $1.50 (not required of female); issued by county clerks and duly appointed agents throughout the State. Licenses not issued to persons under 14 years of age, who may hunt with gun on own premises or those of parent, relatives, or guardian only. Unlawful to hunt with dog or gun on cultivated or inclosed land of another without permission of owner, occupant, or agent. Unlawful to shoot from highways on railroad rights-of-way. Licenses issued free of charge by county clerks only to pioneers of State who arrived prior to 1860 and veterans of Indian and Civil Wars upon proof of service.

Bag limits and possession: Two deer a season; 5 silver-gray squirrels and 10 quail in 7 consecutive days; 5 sage hens a day, 10 in 7 consecutive days in district 2, except in Harney and Malheur Counties, the limit is 15 in 7 consecutive days; 5 ruffed grouse, pheasants, sooty or blue grouse, sage hens, prairie chickens, and Chinese pheasants (only 1 of which may be a female) a day, 10 in 7 consecutive days; 10 doves (State) a day, 20 in 7 consecutive days; 25 ducks, 8 geese, 8 brant, 25 Wilson snipe, 15 in all of plovers and yellowlegs, 25 in all of rails, coots, and gallinules a day but not more than 30 in all in 7 consecutive days. Migratory game birds properly tagged may be possessed during first 10 days of close season; other game, when properly tagged, during close season.

Sale: Sale of all protected game prohibited. Game birds (except migratory birds) and animals imported from without the United States, when duly tagged, may be sold September 1 to March 1. Tag fee, 5 cents each. Commissioners may make regulations permitting the sale of game, except migratory birds.

Export: Export of all protected game prohibited.

PENNSYLVANIA.

Open season:[1]

Deer—male with horns 2 inches above the hair	Dec. 1–Dec. 15.
Bear	Oct. 15–Dec. 15.
Hare, rabbit	Nov. 1–Dec. 15.
Squirrels, quail, ringneck pheasant, Hungarian partridge, woodcock	Oct. 20–Nov. 30.
Wild turkey	Nov. 15–Nov. 30.
Duck, goose, brant	Sept. 16–Dec. 31.
Black-bellied and golden plovers, yellowlegs, coot (mudhen), gallinules, Wilson snipe or jacksnipe	Sept. 16–Nov. 30.
Rail, black bird	Sept. 1–Nov. 30.

No open season: Elk (1921), doe, fawn, ruffed grouse, dove, reedbird, loon, grebe.

Hunting licenses: Nonresident, $10. Issued by commission or county treasurer. Resident, $1 from county treasurer, $1.15 from justice of the peace. Licenses not issued to minor under 14 years of age, and minor between 14 and 16 must furnish written consent of parent or guardian. Licensee required to wear tag.

Resident citizen and members of family residing upon and cultivating land in State as either owner or lessee may hunt on such land and, with consent of owner, on adjoining land without a license.

Aliens not permitted to hunt.

Bag limits and possession: One deer (6 to party camping or hunting together), 1 bear (3 to party camping or hunting together), 60 rabbits, 15 hares, 20 squirrels, 1 turkey, 25 quail (Virginia partridge), 24 ruffed grouse, 10 ringneck pheasants, 10 Hungarian quail, 20 woodcock a season. Ten rabbits, 3 hares, 6 squirrels, 8 quail (Virginia partridge), 4 ruffed grouse, 4 ringneck pheasants, 4 Hungarian quail, 6 woodcock, 25 ducks, 8 geese, 8 brant, 25 Wilson snipe, 15 in all of plovers and yellowlegs, 25 in all of rails, coots, and gallinules a day. Possession of migratory birds permitted during first 10 days of close season; other game during first 30 days thereof.

Sale: Sale prohibited of wild deer, elk, squirrel, rabbit or hare, wild ringneck pheasant, and Hungarian partridge taken in the State; and of quail, ruffed grouse (pheasant), wild turkey, and migratory birds (wherever taken), provided, bear, blackbirds, Belgian and German hares may be sold at any time.

Export: The export is prohibited of all protected game, provided, a nonresident licensee may take out with him on the same conveyance one day's limit of game. Small game to be carried upon the person in hunting coat or game bag, or as hand baggage, without cover. Packages containing large game to be plainly marked. Shipment by parcel post prohibited.

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[1] *Pennsylvania:* Seasons may be closed on petition to commission.

Miscellaneous: Use of automatic guns prohibited.

RHODE ISLAND.

Open seasons:

Gray squirrel, hare, rabbit, quail or bobwhite, ruffed grouse or partridge, pheasant	Nov. 1–Dec. 31.
Duck, goose, brant, coot, gallinules	Oct. 1–Jan. 15.
Black-bellied and golden plovers, yellowlegs	Aug. 16–Nov. 30.
Wilson snipe	Oct. 1–Nov. 30.
Woodcock	Nov. 1–Nov. 30.
Rails (other than coot and gallinules)	Sept. 1–Nov. 30.

No open season: Deer,[1] dove, Hungarian partridge (1920).

Hunting licenses: Nonresident, $10.15; alien, $15.15; resident, $1.15. Issued by city and town clerks.

Not required of resident or his immediate family to hunt on own or leased agricultural lands on which actually domiciled; nonresident owning real estate valued at not less than $500, and nonresident member of club incorporated for hunting or fishing purposes prior to Jan. 1, 1909, which owns real estate assessed for taxation at value of not less than $1,000, may procure license at a fee of $1.15; licenses not issued to minors under 15 years of age. Consent of owner required for hunting on land of another from Oct. 15–Dec. 15.

Bag limits: Fifteen ducks, 8 geese, 8 brant, 6 woodcock, 15 in all of plovers and yellowlegs, 15 Wilson snipe, 15 in all of rails, coots, and gallinules a day, but not more than 15 game birds of all kinds in possession at one time. Possession of waterfowl, coots, gallinules, and woodcock permitted during first 10 days of close season.

Sale: Sale of all protected game birds prohibited.

Export: Export prohibited of all game, provided a nonresident licensee may take out under his license 10 wild fowl or birds in one calendar year, if carried open to view.

SOUTH CAROLINA.

Open seasons:

Deer (see exceptions)	Sept. 1–Dec. 31.
Exceptions: In Berkeley and Dorchester Counties, Aug. 1–Jan. 31; in Barnwell, Dillon, Florence, and Marion, Aug. 1–Dec. 31; in Beaufort, Sept. 15–Jan. 15; in Colleton, Sept. 1–Jan. 31; in Georgetown, Oct. 1–Jan. 15; in Greenville, Oct. 15–Feb. 15; in Hampton and Jasper, Aug. 15–Jan. 15; in Richland, 1921.	
Squirrel (see exceptions)	Unprotected.
Exceptions: In Chesterfield and York, Oct. 1–Dec. 31; in Greenville, Oct. 15–Feb. 15; in Greenwood, Dec. 1–Feb. 28; in McCormick, Dec. 1–Mar. 30.	
Quail (partridge), wild turkey (see exceptions)	Nov. 15–Mar. 15.
Exceptions: Quail, in Charleston, Nov. 20–Feb. 15; in Cherokee, Dec. 16–Jan. 15;[2] in Chester, Fairfield, and Union, Dec. 1–Feb. 28; in Chesterfield, Nov. 15–Jan. 15; in Darlington, Dillon, Lancaster, McCormick, and York, Dec. 1–Jan. 31; in Greenville, Nov. 25–Feb. 15; in Greenwood, Dec. 1–Feb. 15; in Marlboro, Nov. 15–Feb. 15. *Wild turkey,* in Abbeville, Chester, Lancaster, and York, Dec. 1–Jan. 31; in Failfield, Dec. 1–Feb. 28; in Greenville, Oct. 15–Feb. 15.	
Dove (see exceptions)	Sept. 16–Dec. 31.
Exceptions: In Aiken, Dec. 1–Dec. 31; in Greenville, Oct. 15–Dec. 31.	
Duck, goose, brant, coot, gallinules, Wilson snipe	Nov. 1–Jan. 31.
Black-bellied and golden plovers, yellowlegs	Sept. 1–Dec. 15.
Rails other than coot and gallinules	Sept. 1–Nov. 30.[3]
Woodcock	Nov. 1–Dec. 31.
Grackle	Oct. 1–Feb. 28.[3]

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[1] *Rhode Island:* Deer injuring crops may be killed at any time by the owner or occupant of the premises under written permit from secretary of state.

[2] Quail may be hunted in Cherokee County by landowner or by his written permit on his own land from Dec. 16 to Jan. 14, inclusive.

[3] In Greenville County the season on rail and grackle does not open until October 15.

No open season: Reedbird.

Hunting licenses: Nonresident, $15.25, issued by county clerk. Resident, State, $3; county of residence, $1.10. Issued by county clerk or game warden.

No license required of resident owners, tenants, and their children on own lands, or on public lands and waters in county of residence, or of persons to hunt on land of another in county of residence with written permission of owner.

Unlawful to hunt on land of another without consent of owner.

No resident license required in counties of Aiken, Berkeley, Cherokee, Chesterfield, Clarendon, Colleton, Georgetown, Greenwood, Jasper, Lancaster, Marlboro, Williamsburg, and York, or in townships of Bluffton and Yemassee in Beaufort County.

Bag limits: Five deer a season, 25 quail (partridge), 25 doves, 2 turkeys a day; 15 quail in Charleston County a day; 25 ducks, 8 geese, 8 brant, 6 woodcock, 25 Wilson snipe, 15 in all of plovers and yellowlegs, 25 in all of rails, coots, and gallinules a day. Possession of migratory birds permitted during first 10 days of close season.

Sale: Sale prohibited of deer, quail (partridge), dove, turkey, and all migratory birds.

Export: Export prohibited of all protected game taken in State; provided, a nonresident licensee may export 2 deer, 50 quail, 12 ruffed grouse; 4 turkeys, 50 in all of plover, yellowlegs, and snipe, 50 waterfowl if not for sale and packages are marked to show contents, but not more than two days' limit of migratory birds shall be exported in any one calendar week.

SOUTH DAKOTA.

Open seasons:

Deer	Nov. 1–Nov. 30.
Partridge, grouse, prairie chicken	Sept. 7–Oct. 6.
Duck, goose, brant, coot, gallinules, Wilson snipe	Sept. 16–Dec. 20.
Golden plover, yellowlegs	Sept. 16–Oct. 6.
Woodcock	Oct. 1–Nov. 30.
Rails, other than coots and gallinules	Sept. 1–Nov. 30.

No open season: Elk, antelope, mountain sheep, quail, dove, pheasant.

Hunting licenses: Nonresident: Big game, $25; small game, $15; issued by game warden or county treasurer. Resident: Big game, $5; small game, $1; issued by county treasurer. Hunting game birds during open season on own land permitted without license.

Bag limits and possession: One deer a year; 15 ducks, 8 geese, 8 brant, and 5 of each other species of game birds a day; 35 ducks, geese, or brant, or other aquatic fowl, and 15 prairie chickens, grouse, and plover in possession. Possession permitted during open season and five days thereafter.

Sale: Sale of all protected game prohibited; provided, skins, heads, and antlers of deer lawfully killed may be sold.

Export: Export of all protected game prohibited; provided, a nonresident may export 1 deer lawfully killed under permit of State game warden and not more than 10 birds under each of five tags attached to his license, but not more than 50 ducks, 16 geese, 16 brant, 12 woodcock, 50 snipe, 30 in all of plovers and yellowlegs, and 50 in all of rails, coots, and gallinules shall be exported by one person in any one calendar week.

TENNESSEE.

Open seasons:

Deer (see exception)	No open season.
Exception: In Bledsoe, Cumberland, Grundy, Marion, Sequatchie and Van Buren Counties	Nov. 1–Dec. 10.
Squirrel (see exceptions)	June 2–Dec. 31.
Exceptions: In Bledsoe, Cannon, Cumberland, Grundy, Lincoln, Marion, Sequatchie, Sumner, and Van Buren Counties unprotected; in Dickson, June 1–Nov. 1; in Dyer, June 1–July 1 and Oct. 1–Jan. 1; in Fayette, Rutherford, June 1–Jan. 1; in Smith and Wilson, May 1–Mar. 1; in Warren, Nov. 1–Mar. 1.	
Rabbit (see exception)	Unprotected.
Exception: In Carter, Dec. 1–Mar. 1; in Johnson, Nov. 15–Feb. 1.	

Quail or partridge, wild turkey (additional season for gobblers, Apr. 2–24) (see exceptions)	Nov. 16–Dec. 31.
Exceptions: Quail, in Bedford, Moore, and Obion Counties, Dec. 1–Jan. 1; in Bledsoe, Cumberland, Grundy, Marion, Sequatchie, and Van Buren, Nov. 1–Jan. 1; in Bradley, Campbell, Carter, and Henry, Dec. 1–Feb. 1; in Carroll, Dec. 1–Jan. 31; in Cannon and White, Nov. 15–Feb. 15; in Crockett, Rutherford, and Sumner, Nov. 15–Jan. 1; in Dickson and Johnson, Nov. 15–Jan. 15; in Dekalb, Nov. 15–Feb. 1; in Fayette, Nov. 22–Mar. 5; in Hardeman, Dec. 15–Mar. 1; in Henderson and Weakley, Dec. 15–Feb. 15; in Hickman and Monroe, Dec. 1–Jan. 15; in Lincoln, Dec. 1–Feb. 15; in McNairy, Dec. 15–Feb. 1; in Sullivan, Nov. 20–Feb. 15; in Washington, Nov. 20–Jan. 1. Season closed in Greene until Nov. 15, 1922.	
Wild turkey, in Bledsoe, Cumberland, Grundy, Marion, Sequatchie, and Van Buren Counties, Nov. 1–Jan. 1, and also on gobblers only, Apr. 1–May 1; in Lincoln, Nov. 1–Mar. 1, and also on gobblers only, Apr. 1–Apr. 25; in Cannon and Sullivan, unprotected.	
Dove (see exceptions)	Sept. 1–Dec. 15.
Exceptions: In Carter, Nov. 1–Dec. 15; in Fayette, Sept. 1–Nov. 1; in Obion, Sept. 1–Sept. 15; in Sullivan, Nov. 20–Dec. 15.	
Duck, goose, brant, coot, mud hen, gallinule, Wilson or jacksnipe	Nov. 1–Jan. 31.
Black-bellied and golden plovers, yellowlegs	Sept. 1.–Dec. 15.
Rail	Sept. 1–Nov. 30.

No open season: Deer (1919), grouse, ringneck and Mongolian pheasant, and woodcock.

Hunting licenses: Nonresident: $10 (may hunt on own land without license). Resident: State, $2; county, $1 (county licensee may obtain State license for $1). Issued by county clerks. County license not required of residents in Cannon, Hardin, Houston, and Jackson Counties, or of residents to hunt squirrels in Dyer, Lincoln, Smith, Wagner, and Wilson Counties.

Owners and tenants may hunt without license on land on which they reside. Unlawful to hunt on tillable or inclosed lands of another without written permission.

Reelfoot Lake: State license required of residents to hunt thereon. Nonresident, fish, $2. Guide or pusher, $1.

Bag limits and possession: Twenty game birds and animals a day but not more than 8 geese, 8 brant, 15 in all of plovers and yellowlegs a day; in Carter County, quail, 20 in possession; in Lauderdale County, 6 squirrels, 12 quail, and 2 turkeys a day or in possession.

Sale: Sale prohibited of migratory birds and of all other protected birds killed in State.

Export: Export of all protected game prohibited, provided nonresident licensee may take out of State, if carried openly, game birds legally killed by him, except 25 birds only may be exported from Reelfoot Lake, but not more than 50 ducks, 16 geese, 16 brant, 10 Wilson snipe, 30 in all of plovers and yellowlegs, 50 in all of rails, coots, and gallinules, and 50 doves shall be exported by one person in any one calendar week.

TEXAS.

Open season:

Deer (male)	Nov. 1–Dec. 31.
Quail or partridge	Dec. 1–Jan. 31.
Prairie chicken, pinnated grouse, introduced pheasant	Nov. 1–Jan. 31.
Wild turkey	Dec. 1–Jan. 31.
Mourning and white-winged doves (see exception)	Sept. 1–Oct. 31.
Exception: Southern district	Dec. 1–Dec. 15.
Duck, goose, brant, Wilson snipe or jacksnipe, coot, gallinules	Oct. 16–Jan. 31.
Black-bellied and golden plovers, yellowlegs	Nov. 1–Jan. 31.
Woodcock	Nov. 1–Dec. 31.
Rails, other than coot and gallinules	Sept. 1–Nov. 30.

No open season: Does, spotted fawns, antelope, sheep, goats (1942).

Hunting licenses: Nonresident, $15; issued by game, fish, and oyster commissioner. Resident, $1.75, not required in county of residence and contiguous counties or on land owned or controlled; issued by commissioner and county clerks.

Bag limits: Three deer, 3 wild turkeys a season; 15 game birds a day but not more than 8 geese, 8 brant, or 6 woodcock. Possession of migratory birds permitted during first 10 days of close season.

Sale: Sale prohibited of all protected game.

Export: Export prohibited of all game, except nonresident licensee may export 3 male deer in open season; 45 ducks and 15 other birds may be exported if accompanied by owner and affidavit of lawful killing and that game is not for sale.

UTAH.

Open season: [1]

Duck, goose, Wilson snipe	Oct. 1–Dec. 31.
Coot, gallinule	Oct. 1–Jan. 15.
Rail other than coot and gallinules	Sept. 1–Nov. 30.

No open season: Male deer (1920), does, fawns, elk, antelope, sheep, quail, partridge, prairie chicken, blue grouse, sage hens, pheasants, doves, shorebirds (except Wilson snipe).

Hunting and fishing licenses: Nonresident citizen, over 14 years, game and fish, $6; resident (male), game and fish, $1.25. Aliens prohibited from hunting or fishing in State. Residents under 14 not required to secure license, and any person may kill rabbits without a license. Issued by State game and fish commissioner or deputy, county clerk, or deputy.

Bag limits: Twenty-five in all of ducks, geese, and Wilson snipe but not more than 6 geese a day; 8 brant, 25 in all of rails, coots, and gallinules a day.

Sale: Sale of partridge, prairie chicken, blue grouse, sage hen, pheasants, quail, and all migratory birds prohibited.

Export: Export of all game prohibited, provided, nonresident licensee may take out one day's limit of game by permission of commissioner after being inspected and properly marked.

VERMONT.

Open seasons:

Deer (with horns not less than 3 inches in length)	Nov. 10–Nov. 20.
Hare, rabbit	Sept. 15–Feb. 28.
Gray squirrel, quail, ruffed grouse (partridge)	Sept. 15–Nov. 30.
Duck, goose, brant, coot, gallinules	Sept. 16–Dec. 31.
Black-bellied and golden plovers, yellowlegs, English or Wilson snipe (jacksnipe)	Sept. 16–Nov. 30.
Woodcock	Oct. 1–Nov. 30.

No open season: Elk (1923), moose, caribou, does, fawns, pheasants, European partridge, dove, rail.

Hunting and fishing licenses: Nonresident: Game and fish, $10.50; owner of real estate in State to value of $1,000, $1; fish, $2. Resident: Game and fish, $1; game, 60 cents; fish, 60 cents. Issued by town clerks.

Hunting licenses not issued to persons under 16 without written consent of parent or guardian. Owners of farm lands, their resident minor children or tenants may hunt without a license during open season on own lands. Fishing licenses not required of persons under 16 or of women.

Bag limits and possession: One deer, 25 ruffed grouse, 25 woodcock a season; 5 hares or rabbits, 5 squirrels, 4 quail, 4 ruffed grouse, 20 ducks, 8 geese, 8 brant, 10 plover, and 10 yellowlegs, but not more than 15 in all, 6 woodcock, 10 Wilson snipe, 25 in all of coots and gallinules a day.

Possession of waterfowl, coots, and gallinules permitted during first 10 days of close season.

Sale: Sale of all protected game birds prohibited; deer may be sold during open season and for a "reasonable time thereafter," and hares and rabbits during the open season.

Export: Export prohibited of all protected game, except hares and rabbits; provided, a nonresident licensee may export one deer and one day's bag limit of game birds under permit, but must accompany shipment; resident may export (if not for sale) one day's bag limit of game birds under special permit from commissioner.

VIRGINIA.

Open seasons: [2]

Deer (see exceptions)	Sept. 1–Dec. 1.
Exceptions: In Chesterfield, Mecklenburg, Prince George, and Surry	Oct. 1–Jan. 1.
In Brunswick and Greenesville	Oct. 1–Feb. 1.

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[1] *Utah:* Commissioner may open and fix seasons and bag limits on quail, pheasants, and sage hens.

[2] *Virginia:* Boards of supervisors may shorten the open season in their counties and make other restrictions not repugnant to law, "and may include in such protection other game not specifically mentioned in this section." (Code 1904, sec. 2070a, as amended in 1906.) These changes are not included in this table.

In Amelia and Nottoway	Nov. 1–Dec. 31.
In Augusta (1919); Bath and Highland (1921); Shenandoah (1920); *deer* 1921 and *elk* 1923 in Alleghany, Bland, Botetourt, Craig, Franklin, Giles, Montgomery, Patrick, Pulaski, Rockbridge, Rockingham, Russell, and Wythe Counties.	
Rabbit[1]	Nov. 1–Feb. 1.
Squirrel,[2] in Amelia, Brunswick, Caroline, Charles City, Greenesville, James City, New Kent, Nottoway, Spotsylvania, Stafford, Warwick, and York Counties	Nov. 1–Feb. 1.
In Loudoun	June 1–Oct. 31.
In Isle of Wight and Southhampton	Sept. 1.–Jan. 15.
In Rappahannock	Nov. 1–Jan. 31.
In Shenandoah	Aug. 15–Oct. 1.
In Warren	Nov. 15–Jan. 1.
In rest of State	Unprotected.
Quail or partridge, pheasant or grouse, wild turkey (see exception)	Nov. 1–Feb. 1.
Exception: West of the Blue Ridge	Nov. 1–Dec. 31.
Dove	Sept. 1–Dec. 15.
Duck, goose, brant,[3] Wilson snipe or jacksnipe, coot, mudhen gallinules	Nov. 1–Jan. 31.
Black-bellied and golden plovers, yellowlegs	Aug. 16.–Nov. 30.
Woodcock	Nov. 1–Dec. 31.
Rail, other than coot and gallinules	Sept. 1–Nov. 30.

No open season: Pheasant, Middlesex County (1919); ringneck pheasant, Shenandoah (1920). By order of commissioner, approved by governor, introduced pheasants protected throughout State until September 1, 1920; in Brunswick County, November 1, 1921.

Hunting licenses: Nonresident, $10; alien, $20 (alien owner of real estate resident for five years, same as resident). Resident: State, $3; county of residence, $1. Issued by clerks of circuit and of corporation courts.

Nonresident may hunt on own land during open season without a license. Owner, members of family, and tenant of land residing thereon may hunt without license during open season on own or adjoining lands with consent of owner.

Bag limits and possession: Twenty-five ducks, 8 geese, 8 brant a day, but not more than 35 in all a day in Back Bay, Princess Anne County; 15 in all of plover and yellowlegs, 25 Wilson snipe, 6 woodcock, 25 in all of rails, coot, and gallinules, 25 doves. Possession of migratory birds permitted during first 10 days of close season.

Local bag limits are as follows: In Shenandoah County, 15 quail or partridges, 3 pheasants or grouse, and 2 wild turkeys a day. In Brunswick County, 15 quail and 2 turkeys a day.

Sale: Sale of quail or partridge, grouse or pheasant, wild turkey and all migratory birds prohibited.

Export: Export of all protected game (except waterfowl legally killed) is prohibited; provided that during open season nonresident may, under his hunting license, take with him out of State, or as baggage on same conveyance, 1 deer, 50 quail or partridges, 10 pheasants or grouse, 3 wild turkeys, and 25 of each or 100 in all of plover and snipe, if killed or captured by himself, shipped open to view, and plainly labeled with his name and address, but more than 2 day's limit of migratory birds shall not be exported by one person in any one calendar week from any part of State. Any citizen of State may ship from State, as a gift and not for sale (which fact must be stated on shipping tag), 1 deer, 18 quail or partridges, 6 pheasants, 3 wild turkeys, if open to view and plainly labeled with names and addresses of donor and donee and number of each kind of bird so shipped.

Back Bay, Princess Anne County: Nonresident licensee permitted to export as personal baggage 25 ducks, geese, or brant he has lawfully killed, but not for sale or barter, but not more than 16 geese or 16 brant in any one calendar week.

Shenandoah County: Licensee may take with him from county as personal baggage, open to view, if plainly labeled, 30 quail or partridges, 6 pheasants or grouse, 2 wild turkeys a season, and any citizen may ship the same quantity of game, as a gift, if not for sale.

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[1] Residents of the State may kill rabbits and squirrels on their own lands at any time.

[2] Residents of the State may kill squirrels on their own lands at any time.

[3] Wild fowl may not be hunted on Wednesdays, Saturdays, and Sundays on Back Bay, Princess Anne County.

WASHINGTON.

Open seasons:

West of Cascades—	
Deer (see exceptions), goat	Oct. 1–Nov. 1.
Exceptions: Deer in Island and San Juan Counties, Jan. 1, 1921; does in Skagit, Snohomish, and Whatcom Counties, no open season.	
Bear	Sept. 1–May 1.
Quail (see exception), ruffed grouse, native pheasant, Chinese pheasant (see exception), blue grouse, ptarmigan	Oct. 1–Oct. 15.
Exceptions: Quail, in Clallam, Clarke, Jefferson, San Juan, Skagit, Skamania, Snohomish, and Whatcom, Oct. 1, 1919. *Chinese pheasants,* in Clallam, Kitsap, and Skamania Counties, no open season.	
Duck, goose, brant, coot	Oct. 1–Jan. 15.
Black-bellied and golden plovers, Wilson snipe or jacksnipe, yellowlegs	Oct. 1–Dec. 15.
Rail	Oct. 1–Nov. 30.
East of Cascades—	
Deer (Kittitas County, Oct. 15–Dec. 1)	Oct. 1–Nov. 15.
Bear	Sept. 1–May 1.
Goat	No open season.
Ruffed grouse (native pheasant), blue grouse (see exception)	Sept. 1–Nov. 15.
Exceptions: In Asotin (in précincts of Clarkston, South Clarkston, and West Clarkston, no open season), Garfield, and Walla Walla, Aug. 15–Oct. 1. *Ruffed grouse* in Kittitas and Yakima Counties, no open season. *Blue grouse* in Spokane County, Oct. 1, 1919.	
Quail in counties of Asotin (in precincts of Clarkston, South Clarkston, and West Clarkston; no open season) and Garfield	Oct. 1–Oct. 10.
Prairie chicken in Stevens County	Sept. 15–Oct. 1.
Sharp-tailed grouse in Ferry and Okanogan Counties	Sept. 15–Nov. 1.
Sage hen, Hungarian partridge, male Chinese pheasant in Kittitas County	Oct. 1–Oct. 10.
Bobwhite quail in Spokane County	Oct. 1–Nov. 1.
Hungarian partridge in Lincoln, Spokane, and Stevens Counties	Oct. 1–Nov. 15.
Chinese pheasants in Benton, Stevens, and Yakima Counties	Oct. 1–Oct. 15.
Duck, goose, brant, coot	Sept. 16–Dec. 31.[1]
Black-bellied and golden plovers, Wilson snipe or jacksnipe, yellowlegs	Oct. 1–Dec. 15.
Rail	Sept. 16–Nov. 30.

No open season: Moose, elk (1925); fawns, caribou, mountain sheep, squirrels (gray, black, fox), quail, prairie chicken, sage hens, introduced birds (except as above), turkey, and dove.

Hunting and fishing licenses: Nonresident: Hunting, $10; fishing, county, $2. Resident: State, $5; county, $1. Issued by county auditors.

No license required of honorably discharged Union soldiers of Civil War to hunt or fish, or of women and persons under 16 to fish, if residents.

Bag limits and possession: One deer in counties east of Cascades. Two deer (1 buck in Skagit, Snohomish, and Whatcom), 1 goat in counties west of Cascades.

Five in all of partridge, grouse, prairie chickens, Hungarian partridge, Chinese or English pheasant a day or in possession; 10 quail a day; 10 upland birds, but in no event to exceed 5 if quail are included in bag, and 25 in all a week. In Kittitas County 2 male Chinese or English pheasants in bag of 5 upland birds; 20 ducks, geese, brant, golden plover, yellowlegs, Wilson snipe a week (week ends at midnight Saturday), but not more than 8 geese, 8 brant, 15 in all of plovers and yellowlegs a day; 30 ducks, geese, brant in possession. Possession during close season permitted under permit, but migratory birds shall not be possessed longer than 10 days after close of open season.

Sale: Sale of all protected game prohibited.

Export: Export of all protected game prohibited.

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[1] *Washington:* No open season on waterfowl on Columbia or Snake Rivers or within ¼ mile of their shores in counties of Benton, Columbia, Douglas, Franklin, Garfield, Grant, Kittitas, Klickitat, Walla Walla, Whitman, and Yakima.

WEST VIRGINIA.

Open seasons:

Deer (with horns more than 4 inches long), ruffed grouse (pheasant), wild turkey	Oct. 15–Nov. 30.
Rabbit (except on own land at any time)	Oct. 15–Dec. 31.
Squirrel	Sept. 16–Nov. 30.
Quail (Virginia partridge)	Nov. 1–Nov. 30.
Duck, goose, brant	Oct. 1–Dec. 31.
Coot, gallinules	Sept. 16–Dec. 31.
Wilson snipe or jacksnipe	Oct. 15–Dec. 15.
Black-bellied and golden plovers, yellowlegs	Sept. 16–Dec. 15.
Woodcock	Oct. 1–Nov. 30.
Rail (ortolan) other than coot and gallinules	Sept. 1–Nov. 30.

No open season: Elk (1923), does, fawns, imported pheasants, capercailzie and other introduced foreign game birds, dove.

Hunting licenses:[1] Nonresident, $16. Resident: State, $3; county of residence, no fee, issued by county clerk. Aliens not permitted to hunt. License issued to minor under 15 on consent of parent or guardian. Unlawful to hunt on inclosed or improved lands without written permission of owner.

Bag limits and possession: Two deer a season; 12 squirrels a day, 100 a season; 12 quail a day, 96 a season; 6 ruffed grouse a day, 25 a season; 2 wild turkeys a day, 6 a season; 25 ducks, 8 geese, 8 brant, 6 woodcock, 25 Wilson snipe, 15 in all of plovers and yellowlegs, and 25 in all of rails, coots, and gallinules a day. Possession of migratory birds permitted during first 10 days of close season; other game during first 20 days thereof.

Sale: Sale prohibited of all protected game, except rabbits may be sold during open season.

Export: Export prohibited of deer, venison, squirrel, quail, ruffed grouse (pheasant), wild turkey, woodcock, geese, brant, ducks, plover, snipe. Not more than two days' limit of other migratory birds shall be exported by one person in any one calendar week.

Miscellaneous: Unlawful to discharge firearms across any public road, within 400 feet of any schoolhouse, or on the lands of another within 600 feet of an occupied dwelling house.

WISCONSIN.

Open season:

Deer in Pierce, Barron, Trempealeau, Jackson, Wood, Marathon, Shawano, Oconto, and all counties north thereof		Nov. 21–Nov. 30.
In rest of State		No open season.
Bear		Nov. 10–Dec. 1.
Rabbit (see exceptions)		Sept. 7–Feb. 1.
Exceptions: In Clark, Green, and Wood Counties	Oct. 15–Feb. 1.	
In Dane County	Oct. 15–Mar. 1.	
In Dodge, Jefferson, Kenosha, Ozaukee, Racine, Walworth, Washington, and Waukesha Counties	Nov. 1–Jan. 1.	
In Columbia, Crawford, Door, Grant, Iowa, Jackson, Juneau, Monroe, Outagamie, Pierce, Polk, Richland, Rusk, Sauk, Sawyer, Sheboygan, and Winnebago Counties	Unprotected.	
Squirrels (see exceptions)		Oct. 15–Jan. 1.
Exceptions: In Dodge, Kenosha, Milwaukee, Ozaukee, Racine, Washington, and Waukesha Counties	No open season.	
Duck, coot or mud hen, gallinules		Sept. 16–Dec. 10.
Goose, brant, Wilson snipe or jacksnipe, black-bellied and golden plovers, yellowlegs		Sept. 16–Dec. 20.
Rails other than coot and gallinules		Sept. 7–Nov. 30.

No open season: Elk, moose, quail, pheasants (Chinese, English, Mongolian), Hungarian partridge, woodcock, dove, swan, ruffed grouse, spruce hen, sharp-tailed grouse, prairie chicken (1919).

Hunting and fishing licenses: Nonresident: All game and fish, $50; all game (except deer) and fish, $25; fish, $1 (not required in outlying waters or of person under 16);

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[1] *West Virginia:* Fishing license: Nonresident, $5, issued by county clerk.

settlers, $1; guide, $1. Issued by commissioner. Resident: Game, $1 (deer tag, 10 cents additional). Issued by county clerks.

Hunting licenses not issued to persons under 15 or to aliens, except alien settlers. Hunting prohibited in fields of growing grain or on lands of another without consent of owner.

Bag limits and possession: One deer a season; squirrels, 5 a day; rabbits, 5 to 10 a day in certain counties; other counties no limit; 8 geese, 8 brant, but not more than 10 in all a day; duck (including coot or mud hen), plover, snipe, rail, rice hen, 15 a day; mixed bag limit of 20 a day is permitted, but containing not more than the bag limit of any one variety; 15 yellowlegs, but not more than 15 in all of plovers and yellowlegs a day.

Possession at any time of deer duly tagged permitted for private use by person killing it. Possession at any time prohibited of game by person without hunting license or scientist's certificate.

Sale: Sale of all protected game prohibited (except rabbit). Rabbits may be sold during open season.

Export: Export of all protected game prohibited, except nonresident licensee may transport, during last 10 days of November, 1 deer duly tagged if he accompanies shipment and may take in his personal possession, openly, a mixed bag of not more than 20 game birds legally killed, but not more than the bag limit for one day of any one variety.

Export permitted of specimens of birds and animals (except deer) taken under permits from State authorities and, if migratory birds are included, from Secretary of Agriculture, for scientific purposes. Park boards allowed to ship, under permit of State game warden, live animals and game birds for park purposes.

WYOMING.

Open seasons.

Deer (see exception)	Oct. 1–Nov. 15.
Exception: In Campbell, Crook, Johnson, Niobrara, Sheridan and Weston Counties	Oct. 15–Oct. 31.
Elk and male sheep in Lincoln, Park, and Fremont Counties (except Bridger National Forest and north of Big Wind River and south of Sweetwater River)	Sept. 1–Nov. 15.
Grouse (other than sage grouse)	Sept. 1–Nov. 15.
Sage grouse	Aug. 1–Sept. 1.
Duck, goose, coot, gallinules, black-bellied and golden plovers, Wilson snipe, yellowlegs	Sept. 16–Dec. 16.
Rails other than coot and gallinules	Sept. 1–Nov. 30.

No open season: Elk (except as above), moose, antelope, quail, Mongolian pheasant (1919), dove.

Hunting and fishing licenses: Nonresident: General, $50 (fee $2.50 if applicant pays $100 taxes in State); bear, $10; birds and fish, $5; each nonresident hunting big game must be accompanied by a guide. Alien: Gun and fish, $25 (not required of holder of $50 hunting license, or resident alien freeholder paying $100 taxes, settler on public lands who has initiated proceedings to acquire title thereto, or of persons engaged in herding sheep). Resident: General, $2.50 (not issued to minor under 15); birds, $1 (not issued to minor under 14); special elk license, $10 (1 additional animal). Guide: Citizen only, $10 (bond, $500). Licenses issued by justice of peace and assistant and deputy wardens. Unlawful to hunt on inclosed lands of another without consent of owner.

Bag limits and possession: One deer, 2 elk (resident, 1 elk under general license, 1 additional elk under special license), 1 sheep, a season; 18 birds, of which not more than 6 may be sage hens or grouse (2 sage hens in Laramie and Sheridan Counties) a day or in possession, but must not include more than 8 geese, 8 brant, or 15 in all of plovers and yellowlegs.

Sale: Sale of all game of State prohibited; provided, the sale of game (except edible portion) is permitted when properly tagged. Justice of peace issues tags (fee, 25 cents) under affidavit that game was lawfully captured or killed. No sale of migratory birds permitted.

Export: Export of all protected game prohibited; provided, game may be exported if properly tagged, by a justice of the peace, fee 25 cents. Game tags issued under affidavit of lawful killing, and, if edible portion, that it is not for sale. Smithsonian

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[1] *Wyoming:* Hunting of big game permitted in Lincoln County on Fall River rim or crest in cattle districts 1, 3, and 5 in Wyoming National Forest, Oct. 5–Nov. 30.

Institution or other well-known scientific institutions may export any game animals or birds under permit of State game commission. Exchange of game animals and birds for liberation in Wyoming allowed under permit of the State game commission. Not more than 50 ducks, 16 geese, 16 brant, 50 Wilson snipe, 30 in all of plovers and yellowlegs, or 50 in all of rails, coots, and gallinules shall be exported by one person in any one calendar week.

CANADA.

Under the act of August 29, 1917, to give effect to the migratory-bird treaty between the United States and Great Britain the governor general in council has promulgated regulations for the protection of migratory birds in Canada.[1] These regulations restrict the hunting of migratory game birds not protected throughout the year to a period not exceeding 3½ months between September 1 and January 15, inclusive, in all the Provinces, except the Maritime Provinces, where the 3½ months open season on shorebirds opens August 15 and closes November 30. Other provisions of the regulations also conform to the terms of the treaty.

Canada also has a general law prohibiting export of deer (except those raised on private preserves), wild turkeys, quail, partridges, prairie fowl, and woodcock, but permitting each nonresident to export two deer (except in those Provinces further limiting the number) in a year at certain ports within 15 days after the close of the open season, under permit of the collector of customs of the port from which export is made. The ports of export are Halifax and Yarmouth, Nova Scotia; Macadam Junction, New Brunswick; Quebec and Montreal, Quebec; Ottawa, Kingston, Niagara Falls, Fort Erie, Windsor, Sault Ste. Marie, and Port Arthur, Ontario; and such others as the minister of customs may designate.

ALBERTA.

Open season: [2]

Deer (male), bull moose, caribou	Nov. 1–Dec. 14.
Sheep (male), goat	Sept. 1–Oct. 14.
Grouse, partridge, pheasant, prairie chicken, ptarmigan, Hungarian partridge	Oct. 1–Oct. 31.
Duck, goose, Wilson snipe or jacksnipe, black-breasted and golden plovers, yellowlegs, rail	Sept. 1–Dec. 14.

No open season: Elk or wapiti, buffalo, females of deer, moose, sheep, young of all big game, antelope (1925), Hungarian pheasant.

Hunting licenses: Nonresident: General, $25; bird, $5. Resident: Big game, $2.50; birds, $2.25 (required only south of Lat. 55°); not required of farmer or member of family residing with him on farm; guide, camp help, $2.50; market hunter, $5. Farmers or their sons residing on own land, big game, $1. Issued by minister of agriculture. Residents north of latitude 55° may also take one head of big game (except elk or buffalo) without big-game license.

Bag limits: Deer, moose, caribou, 1 of each species, 2 sheep, 2 goats a season; grouse, partridge, pheasant, prairie chicken, ptarmigan, 10 a day, 100 a season; Hungarian partridge, 5 a day, 25 a season; 30 ducks a day, 200 a season.

Sale: Sale of grouse, partridge, pheasant, prairie chicken, ptarmigan, Hungarian partridge prohibited. Other game birds may be sold under license during open season. The flesh of big game may be sold under $10 license. Heads of big game before being sold must be stamped by minister of agriculture at fee of $5 for elk, caribou, moose, sheep; and $2 for deer, antelope, and goat.

Export: Export of all protected game prohibited, except minister of agriculture may grant permits for export of game at the rate of $5 for each head of big game and $1 per dozen for game birds. The holder of a general nonresident license may take with him out of the Province as trophies heads, skins, and hoofs of big game legally killed by him. Any person may export mounted or branded heads at a fee of $1 for each head. Export of migratory birds prohibited during close season.

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[1] Full text of the regulations will be found on pages 65–68.

[2] *Alberta:* North of latitude 55° any game animal or bird, except elk and buffalo, may be killed at any time if needed for food.

BRITISH COLUMBIA.

Open seasons: [1]

Deer, male caribou (see exceptions), goat ---------- Sept. 1–Dec. 15.

Exceptions: Deer west of Cascades (except Queen Charlotte Islands, no open season) ---------- Sept. 15–Dec. 15.

Caribou in Rainbow and Hatchie Mountains in Prince Rupert electoral district, and on Queen Charlotte Islands ---------- No open season.

Bull moose (in Atlin, Caribou, Columbia, Fort George, and Omineca, electoral districts only) ---------- Sept. 1–Dec. 15.

Male sheep (except in North and South Okanogan, Similkameen, and Yale electoral districts, no open season) ---------- Sept. 1–Nov. 15.

Ruffed grouse (see exceptions); blue grouse (west of Cascades only) ---------- Sept. 15–Nov. 14.

Exceptions: Ruffed grouse in electoral districts of Chilliwack, Delta, Dewdney, Richmond, South Vancouver, and district municipality of North Vancouver ---------- Oct. 15–Nov. 14.

Quail in district municipality of Penticton only ---------- Oct. 15–Oct. 29.

Pheasants (cocks) in Chilliwack electoral district ---------- Oct. 15–Nov. 14.

In districts of Dewdney, North and South Vancouver, Richmond, and Similkameen, and on Denman and Hornby Islands in Comax District ---------- Oct. 15–Oct. 28.

In districts of Cowichan and Delta ---------- Oct. 15–Oct. 20.

Remainder of Province ---------- No open season.

European partridge, in Delta district only ---------- Oct. 15–Oct. 20.

Waterfowl, rails, woodcock, jacksnipe or Wilson snipe, black-breasted and golden plovers, yellowlegs:

Northern District [2] ---------- Sept. 1–Dec. 14.

Southwestern District [2] ---------- Oct. 1–Jan. 14.

Southeastern District [2] ---------- Sept. 15–Dec. 31.

No open season: Buffalo, elk, young of deer and goat, and females and young of moose, caribou, and sheep.

Hunting and fishing licenses: Nonresident: General, $25 and $25 additional for each grizzly bear, moose, sheep, wapiti, or caribou, $15 additional for each black or brown bear, mountain goat, or mule deer, and $5 additional for every deer of any other species shot by him; birds, $50; bear, Jan. 1–July 1, $25; angling, season $5, or $1 per day up to five days; British subject, birds, $5 per week. Resident and members of Army, Navy, or Militia on duty in Province: Deer and birds, $2.50; big game and birds, $5. Resident: Big game, birds and trapping, $10; guide, $5. Issued by warden or any person authorized by him.

No fee required of farmer or member of family for license to hunt birds and deer on land on which he resides. Free license granted to prospector under certain conditions upon production of free miner's certificate. No license issued to person under 16 without written consent of parent or guardian and then to hunt with firearms only under supervision of licensed adult. Unlawful to hunt on cultivated, cleared, or inclosed land without owner's consent.

Badge to be worn by licensee. Firearms not to be carried without license.

Bag limits and possession: Three deer of any species, 4 in all; 1 elk, 1 moose, 2 caribou, 2 goats, 2 sheep of any one species, 3 in all, 250 ducks a season; 6 pheasants, 6 Hungarian partridge, and 12 grouse a day. Flesh of big game may be possessed for six weeks after close of open season.

Sale: Sale prohibited of all game except under regulations of lieutenant governor in council.

Sale permitted of moose and caribou (bulls over 1 year) in electoral districts of Atlin, Caribou, Fort George, and Omineca, October 1–December 15, inclusive. Sale of big game without head attached prohibited. Heads of big game killed without and imported into Province may be sold when branded. Fees, moose and elk, $5; mountain sheep, $4; caribou, $3.

Export: Export prohibited of all protected game except under permit of game conservation board. Any animal or bird, dead or alive, may be exported for scientific, zoological, or Government purposes under permit of game conservation board. Live game birds or animals held in captivity under written permission of game conservation board may be exported. Export of migratory birds prohibited during close season.

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[1] *British Columbia:* No hunting permitted on Kalen Island, Colony farm, and in portion of Burnaby municipality.

[2] For definition of districts, see Regulations, p. 66.

Miscellaneous: Use of automatic guns prohibited. Pump guns may be used but must only be capable of holding one cartridge in magazine.

MANITOBA.

Open seasons:

Deer, moose, caribou, or reindeer, antelope or cabri (males)	Nov. 20–Dec. 10.
Ptarmigan	Oct. 1–Oct. 20.
Duck, goose, brant, coot, gallinule, Wilson snipe, black-breasted and golden plovers, yellowlegs, rail, and woodcock	Sept. 15–Nov. 30.

No open season: Bison or buffalo, elk, females and young of big game, dove; quail, pheasant, Hungarian partridge, introduced game bird (1927), grouse, prairie chicken.

Hunting licenses: Nonresident alien, big game, $25; birds, $25. Nonresident British, big game, $15; birds, $10. Resident: Big game, $4; birds, $1. Issued by minister of agriculture. Hunting prohibited on inclosed or cultivated lands, lands covered by buildings or water, without consent of owner. No license required of farmers or members of family to hunt on farm on which they reside.

Bag limits and possession: One in all of deer, moose, caribou, and antelope a season; 15 ptarmigan a day, 50 a season; 20 ducks a day in September, 40 a day in October and November; 10 geese a day. Possession of ptarmigan allowed for 10 days after close of hunting season. Venison for private use may be possessed at any time on proof of legal killing.

Sale: Sale prohibited of deer, elk, moose, caribou, antelope (except heads and hides), and all protected game birds.

Export: Export prohibited of all protected game except under permit issued by department of agriculture. No permit shall be issued for export of ptarmigan, prairie chicken, partridge, grouse, geese, ducks, or entire carcass of any moose, elk, caribou, or deer; provided, nonresident licensee under permit issued free may export carcass of moose, caribou, or deer, and not more than 50 geese and 50 ducks killed by him. (No duck shall be exported before Oct. 1.) Export of migratory birds prohibited during close season.

Miscellaneous: Hunters must wear complete outer suit and cap of white material. Automatic guns prohibited in hunting waterfowl and ptarmigan.

NEW BRUNSWICK.

Open seasons:

Deer (see exception), moose (bulls)	Sept. 15–Nov. 30.
Exception: Deer on Grand Manan and Campobello Islands, no open season.	
Waterfowl, rails	Sept. 1–Dec. 14.
Woodcock, jacksnipe or Wilson snipe	Sept. 15–Nov. 30.
Black-breasted and golden plovers, yellowlegs	Aug. 15–Nov. 30.

No open season: Caribou (1921); calf under 3 years and cow moose; pheasant; partridge, 1921.

Hunting licenses: Nonresident: General, $50; bird, $10; Westmoreland County, $25; fish, $5. Resident: Big game, $2; sinkbox for waterfowl, $1; guide, $2; camp help, $1. Big game license not issued to person under 18. Issued by Crown Land Department. Nonresident licensee must have registered guide.

Bag limits and possession: Two deer, 1 moose (lumber camp limited to 2 moose) a season; 20 ducks, 10 partridges, 10 woodcock a day. Game may be kept for personal use in cold storage during close season under permit.

Sale: Sale of carcass of moose and deer (except head or hide) prohibited; woodcock until September 15, 1919; of other game during close season; provided game (except migratory birds) may be sold during life of 10-day permit applied for within 10 days after close of season. Keepers of hotels, inns, etc., may serve game during open season and 15 days thereafter. Dealer under $1 license from surveyor general may sell three deer at retail and heads and hides to taxidermists; and hides and skins of animals may be sold under license by nonresidents or aliens, fee, $25; and residents, fee, $2.

Export:[1] Export of all game prohibited, except that surveyor general may issue license to export game alive or dead.

Miscellaneous: Automatic guns prohibited in hunting big game and waterfowl.

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[1] *New Brunswick:* Except in the case of partridge the prohibition applies only to common carriers.

NORTHWEST TERRITORIES.[1]

Open seasons:[2]

Deer and moose (males only), mountain goat	Sept. 1–Apr. 1.
Mountain sheep, caribou	Aug. 1–Oct. 1. Dec. 1–Apr. 1.
Partridge, prairie chicken, ptarmigan, and other grouse	Sept. 1–Jan. 1.
Waterfowl, rails, Wilson snipe, black-breasted and golden plovers and yellowlegs	Sept. 1–Dec. 14.

No open season: Buffalo or bison; musk ox, wapiti or elk, does, cow moose; females of caribou, sheep, and goat with young, and young of any of such animals; swan (1928); eider duck (1923); woodcock. Hunting prohibited on Victoria Island.

Hunting and trapping licenses: Nonresident, $50; nonresident British subject, $25; resident, $2; trading or trafficking in game: nonresident, $100; nonresident British subject, $50; resident, $5. Issued by Commissioner of Dominion Parks. Native-born Indians, Eskimos, or half-breed bona fide residents of Northwest Territories may hunt without a license.

Bag limits: Two bull moose, 2 male deer, 4 caribou; mountain sheep, 2 of any species, 3 in all; mountain goat, 2 of any one species.

Sale: Sale of protected game during close season prohibited.

Export: Export of the meat of any game prohibited.

NOVA SCOTIA.

Open seasons:

Deer, male (except on Cape Breton Island, no open season)	Oct. 21–Oct. 31.
Moose, bulls (except on Cape Breton Island, no open season)	Sept. 16–Nov. 30
Caribou, bulls, in Inverness and Victoria Counties only	Sept. 16–Oct. 15.
Hare, rabbit	Oct. 1–Apr. 30.
Waterfowl, rails	Sept. 15–Dec. 31.
Black-bellied and golden plovers, yellowlegs	Aug. 15–Nov. 30.
Woodcock, Wilson snipe	Sept. 15–Dec. 14.

No open season: Females and young of deer, moose, and caribou, Canada grouse (spruce partridge), pheasant; ruffed grouse (birch partridge), 1922.

Hunting licenses: Nonresident: All game, $30; birds and small game, except woodcock and snipe, $15; nonresident paying taxes equal to license fee, $5; alien who has not resided in Province five years, $5; resident to hunt caribou outside county of residence, $5. Guide, resident, $2. Issued by provincial secretary, game commissioners, and county clerks.

Bag limits: One moose a season; 5 ruffed grouse, 10 woodcock a day.

Sale: Sale prohibited of deer, caribou, pheasant, blackcock, capercailzie, Canada grouse (spruce partridge), chukar partridge.

Moose (meat only) may be sold from September 16 to November 1 under certificate showing lawful killing; rabbit, December 1 to April 30; any game bird other than those above mentioned during the open season with the exception of the first three days.

Export: Export prohibited of all protected game, except holder of nonresident general license may ship out of Province under license tag 1 moose lawfully shot by himself. Mounted heads and dressed skins and live mammals or birds for propagating or scientific purposes may be exported under permit from chief game commissioner.

Miscellaneous: Unlawful to use rifle or gun loaded with bullet to shoot wild fowl.

ONTARIO.

Open seasons:[3]

Deer	Nov. 1–Nov. 15.[4]

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[1] *"Northwest Territories"* means the northwest territories formerly known as Rupert's Land and the Northwestern Territory (except such portions thereof as are included in the Provinces of Ontario, Quebec, Manitoba, Saskatchewan and Alberta and the Yukon Territory), together with all British territories and possessions in North America and all islands adjacent thereto not included within any Province, except the Colony of Newfoundland and its dependents.

[2] Indians, Eskimos, bona fide inhabitants, explorers, and surveyors may take game, except musk ox or elk, and the eggs of birds when actually needing them to prevent starvation. Indians and Eskimos may take musk ox for such purposes.

[3] *Ontario:* Lieutenant governor in council may alter close seasons in region north and west of French River, Lake Nipissing, and Mattawa River, and in the vicinity of Rondeau Park, and close for a definite period seasons for any game animal or nonmigratory game bird whose numbers have diminished.

[4] Persons who put deer on their own lands and their licensees may hunt such deer, Oct. 1–Nov. 15.

Moose, caribou (bulls only) (cows and calves under 1 year of age, no open season)	Oct. 1–Nov. 30.[1]
Hare[2]	Oct. 15–Nov. 15. Dec. 23–Jan. 2.
Squirrel (black or gray) (see exceptions)	Nov. 1–Nov. 15.
Exceptions: Elgin, Oxford, and Wentworth (1919).	
Wild turkey	Nov. 1–Nov. 15.
Woodcock, jacksnipe, or Wilson snipe	Oct. 15–Nov. 14.
Ducks	Sept. 1–Dec. 14.
Goose, black-bellied and golden plovers, yellowlegs, rails	Sept. 15–Dec. 14.

No open season: Fawns, elk or wapiti, dove, partridge, grouse, prairie fowl; capercailzie; quail, Hungarian partridge, pheasants (1920).

Hunting licenses: Nonresident: General, $25. Resident: Moose and caribou, $5; deer, $3. Guide, $2. Issued by superintendent of game.

Bag limits and possession: Resident, 2 deer; nonresident, 1 deer, a season; 1 bull moose, 1 caribou a season; 200 ducks a season. Two or more persons hunting together under license may kill an average of 1 deer each. Possession permitted during open season and until March 31, following, of all game except migratory birds.

Sale: The sale of waterfowl prohibited; also partridge (grouse), quail, woodcock, and snipe, prohibited to September 14, 1920. All other native game may be sold during the open season by the person killing it, and by dealers during open seasons and until the following January 1, under license. Hotels, restaurants, and clubs under license may sell during closed season. Imported game may be sold under special regulations and licenses. Game breeders may sell animals for breeding purposes under permit. Sale of migratory birds prohibited during closed season.

Export: The export of all wild game animals and birds is prohibited; provided, 1 deer, 1 bull moose, 1 bull caribou, and 100 ducks may be exported under nonresident hunting license if shipping coupon and, if required, affidavit of lawful killing be attached and contents of packages be open to view. Lawfully imported game and deer, moose, elk, or caribou in private ownership may be exported. Minister may issue permit for the export of game, dead or alive, at any time, except migratory birds during close season.

Miscellaneous: Use of automatic guns prohibited. Unlawful to enter with gun or dog into growing or standing grain without consent of owner.

PRINCE EDWARD ISLAND.

(1918 laws not received.)

Open seasons:

Hare, rabbit	Nov. 1–Feb. 1.
Partridge (in alternate years, 1918, 1920, etc.)	No open season.
Waterfowl, rails	Sept. 1–Dec. 14.
Woodcock, jacksnipe or Wilson snipe	Sept. 15–Nov. 30.
Black-breasted and golden plovers, yellowlegs	Aug. 15–Nov. 30.

Hunting licenses: Nonresident, $15. If applicant pays taxes on real estate valued at $325, fee $5; sons and brothers of residents returning for visit, $2.50; guest, $2. Issued by game inspectors and tax collectors. Hunting on inclosed lands without permission of owner prohibited.

Bag limits and possession: No limits.

Sale: Game lawfully killed may be sold, except migratory birds may not be sold during close season.

Export: Export prohibited of all game except geese and brant; provided, nonresident licensee may carry out of Province 12 birds killed by himself if tagged and carried open to view. Export of migratory birds prohibited during close season.

Miscellaneous: Use prohibited of automatic, pump, machine gun, rifle, or other gun loaded with bullets in hunting game birds.

QUEBEC.

Open seasons:

Deer, bull moose (see exception)	Sept. 1–Dec. 31.
Exception: In Labelle, Ottawa, Pontiac, and Temiscaming Counties	Oct. 1–Nov. 30.
Caribou	Sept. 1–Jan. 31.
Hare	Oct. 15–Jan. 31.

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[1] South of the Canadian Pacific R. R. from Mattawa to Port Arthur, Nov. 1–15.

[2] Hares may be killed during close season by any means other than shooting.

Bear ... Aug. 20–June 30.
Birch or swamp partridge ... Sept. 1–Dec. 14.
White partridge or ptarmigan ... Nov. 1–Jan. 31.
Waterfowl, rails ... Sept. 1–Dec. 14.
Woodcock, jacksnipe or Wilson snipe, black-breasted and golden plovers, yellowlegs (see exception) ... Sept. 1–Dec. 14.
Exceptions: In Bonaventure, Gaspe, Rimouski, and Saguenay Counties ... Aug. 15–Nov. 30.

No open season: Cow moose, young of deer, moose, and caribou, eider duck, pheasant (1920).

Hunting licenses: Nonresident: General, $25 (members of incorporated hunting clubs, $10). Resident, $1 (not required of resident British subject hunting for own use); resident special, $5 (3 deer and 3 caribou additional to limit). Issued by Minister of Colonization.

Bag limits and possession: Two deer, 1 moose, 2 caribou in season; 3 caribou and 3 deer under special resident license. Game lawfully killed may be possessed until 15 days after close of open season.

Sale: Sale of birch or spruce partridge prohibited until October 1, 1920. Game lawfully taken may be sold from the third day of open season to and including the fifteenth day after expiration of open season. Licensed hotels, restaurants, and clubs may serve game lawfully taken, except birch or spruce partridge. Sale of migratory birds prohibited during close season.

Export: Export of moose, caribou, and deer, or parts thereof, prohibited except under permit issued from Minister of Colonization (fee not to exceed $5); also under tags attached to nonresident license not later than 15 days after close of season; export of migratory birds prohibited during close season.

SASKATCHEWAN.

Open seasons: [1]

Deer, elk or wapiti, moose, caribou (males only) ... Nov. 15–Dec. 14.[2]
Duck, goose, coot, Wilson snipe or jacksnipe, black-breasted and golden plovers, yellowlegs, rails ... Sept. 15–Dec. 31.

No open season: Antelope, buffalo, and female of big game and young of big game under 1 year of age.[3] Partridge (ruffed grouse), sage grouse, Canada or spruce grouse, prairie chicken (Sept. 15, 1918).

Hunting licenses: Nonresident: Big game, $25; birds, $15; domiciled in Canada, $5; issued by minister of agriculture. Resident, big game, $5; birds, $1.25 (required of resident of city or town). Issued by minister or agent. No license issued to person under 16 without written consent of parent or guardian. Big-game hunters must wear white suit and cap. Hunting prohibited on inclosed lands without consent.

Bag limits and possession: One elk, 1 moose, 2 deer, 2 caribou, but not more than 2 in all; 50 waterfowl a day, 250 a week.

Sale: Sale of all protected game prohibited.

Export: Export of all protected game prohibited; provided, minister of agriculture may grant permits to export for scientific purposes or propagation in public parks and zoological gardens 1 pair of each species of big game and game birds upon payment of $5, or for propagation a specified number on application of another Province or State. Minister may issue permits to export deer (fee $2 per head) or other big game (fee $5 per head), birds (except grouse family), (fee $1 per dozen, limit 5 dozen per season). Nonresident licensee on leaving Province may take with him during open season personally under his license and permit big game and 100 game birds legally killed. Export of migratory birds prohibited during close season.

YUKON.

(1918 laws not received.)

Open seasons: [4]

Deer, elk or wapiti, moose, caribou, sheep, goat, musk ox (males only) ... Sept. 1–Mar. 1.
Partridge, prairie chicken, grouse, ptarmigan, pheasant ... Sept. 1–Mar. 15.

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[1] *Saskatchewan:* Lieutenant governor in council may extend close seasons over current year, within limits, on petition of six game guardians.

[2] Applies north of line between townships 34 and 35; south of said line no open season.

[3] Male moose and elk having horns less than 6 inches in length deemed to be under 1 year of age.

[4] *Yukon:* Indians, explorers, surveyors, prospectors, miners, and travelers in need of food may take game during close season. Commissioner in council may alter seasons.

Waterfowl, rails, Wilson snipe or jacksnipe, black-breasted and golden plovers, yellowlegs ---------------------------------- Sept. 1–Dec. 14.

No open season: Bison or buffalo and females of other big game.

Hunting licenses: Nonresident, $100. Issued by commissioner or game guardian.

Bag limits: Six caribou or deer, 2 moose, 2 elk, 2 sheep, 2 goats, 2 musk oxen a season.

Sale: Deer, elk, moose, caribou, bison, musk oxen, sheep, and goats may be sold during the open season and 60 days thereafter. Sale of migratory birds prohibited during close season.

Export: Protected game may be exported by a nonresident only under a hunting license and a shipping permit issued by the commissioner of the territory or a game guardian. Heads of game may be exported, if declared before a game guardian. Export of migratory birds prohibited during close season.

COLONY OF NEWFOUNDLAND.

(1918 laws not received.)

Open seasons:[1]

Caribou (except in a special region near Grand Lake, no open season) ---------------------------------- Aug. 1–Sept. 30. Oct. 21–Jan. 31.

Hare, rabbits ---------------------------------- Sept. 20–Jan. 1.

Ptarmigan, willow grouse or partridge, plovers, curlew, snipe, or "other wild or migratory birds (except wild geese)" ------------ Sept. 20–Jan. 1.

No open season: Elk, moose.

Hunting licenses: Nonresident, $51; resident, $5; guide, nonresident, $50, resident, free.

Caribou licenses issued by minister of marine and fisheries, stipendary magistrate, or justice of peace.

Unlicensed guides not to be employed. Guide shall not guide party of more than three sportsmen.

Bag limits: Three caribou (stags) a season by nonresident licensee; 2 stags, 1 doe by resident.

Sale: Caribou may be sold from August 1 to January 1; ptarmigan, willow grouse taken in open season may be sold until January 15; other birds may be sold during open season.

Export: Export for sale prohibited of caribou, partridge, willow or other grouse; provided, minister of marine and fisheries may issue licenses to export caribou for breeding or scientific purposes. Licensee may export three stag caribou under hunting license and export permit (fee, 50 cents); resident may export antlers, head, or skin of caribou under export permit, but not, in either case, for sale.

DISPOSITION OF GAME RAISED IN CAPTIVITY.

Regulations have been adopted under the Federal migratory bird treaty act to permit the propagation and sale of migratory waterfowl,[2] thus paving the way for the upbuilding in this country of an industry from which many persons have been barred by lack of suitable legislation. It has been demonstrated that game animals and birds, especially certain species of migratory waterfowl, will yield satisfactory returns when propagated on farms and preserves. It is believed that the demand for them will far exceed the supply for a number of years, in view of the increased restrictions on the sale of native wild game and of the fact that migratory birds can no longer be sold on the market anywhere in the United States unless they have been reared in captivity in accordance with the new law and regulations. The Department of Agriculture, acting in conjunction with State game officials, will aid so far as possible in establishing this industry, both in preparing drafts of suitable laws to be enacted by the various States and in assisting breeders to obtain eggs and breeding stock. The Department is not and never has been in a position to furnish breeding stock or the eggs of any species of game bird for propagating purposes, contrary to frequent reports in the press, but it will assist legitimate enterprises by granting the necessary permits to propagate waterfowl in captivity and to take birds or eggs for propagating purposes when possible under State laws. Reasonable and proper regulations of Federal and State Governments will permit domesticated game to reach the market for consumption at all seasons and at the same time will prevent the infringement of laws to conserve the supply of native game.

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[1] *Newfoundland:* Poor settlers may kill any birds except capercailzie and black game at any time for immediate consumption by themselves or their families.

[2] Waterfowl are the only migratory birds that are permitted to be raised in captivity, and permits therefor must be obtained from the Secretary of Agriculture, Washington, D. C., in accordance with the regulations (see p. 63).

Federal regulations: Under permit from the Secretary of Agriculture, Washington, D. C., and subject to the provisions of State laws relating thereto, migratory waterfowl may be possessed, sold, and transported at any time for propagating purposes and the unplucked carcasses and the plucked carcasses with heads attached of propagated birds killed by any means other than shooting may be sold and transported at any time to any person for actual consumption, or to the keeper of a hotel, restaurant, or boarding-house, retail dealer in meat or game, or a club, for sale or service to their patrons, who may possess such carcasses for actual consumption without a Federal permit. (See Reg. 8, p. 63, for full details and requirements).

About two-thirds of the States now have some special provision regulating possession, sale, or export of game raised in captivity. The following table giving a digest of the various State laws on the subject serves to show the lack of uniformity and the need of additional legislation to attain the results desired:

Arkansas: The commission may establish rules governing propagation of game in captivity and authorize the sale or export of such game under permit.

California: Game raised in captivity under breeder's license (fee, $2.50) may be sold at any time for breeding purposes or may be sold under license and regulations of commissioners for food when properly tagged (fee, 3 cents a tag). All domesticated game (except deer) must be killed otherwise than by shooting.

Colorado: Game furnished from a private park or lake of class A may be sold by hotels and restaurants at any time. Game taken from licensed private parks may be sold or shipped at any time if accompanied by an invoice.

Connecticut: Deer, pheasants, and wild fowl raised in licensed preserves (fee, $2) may be sold or transported at any time, when duly tagged under regulations of commissioners of fisheries and game.

Delaware: Unlawful to kill, sell, or possess Hungarian partridge or pheasants except for scientific or propagating purposes.

Georgia: Registered breeder may sell game for propagation.

Illinois: Deer raised in inclosure for market may be killed and sold October 1–February 1; cock pheasants, November 1–February 1, under permit. Game animals and birds raised in captivity under license (fee, $2) may be sold for propagating or scientific purposes at any time.

Indiana: Game raised in captivity may be killed, sold, or transported at any time.

Iowa: Game birds raised in captivity under license (fee, $2) may be sold.

Kansas: Game raised in captivity may be transported for scientific or propagating purposes under permit of warden and $1,000 bond.

Kentucky: Game birds and game animals bred in captivity under permit may be sold, transported, or otherwise disposed of at any time when duly tagged.

Louisiana: Game raised in captivity under $5 license may be sold alive for stocking or breeding purposes, and may be killed, transported, and sold for food at any time, if tagged with metal tag. Traffic in birds killed by shooting prohibited.

Maine: Game raised in captivity under a $2 breeder's license may be killed, sold, or transported at any time under regulations of commissioners.

Maryland: Elk and imported and native deer raised in licensed preserve (fee, $5) may be sold, dead or alive, at any time (in Allegany and Garrett Counties white-tailed deer native to the State must be branded three months prior to killing). The propagation and killing of English or ringneck pheasants in captivity is permitted. In Washington County game animals and birds reared in licensed preserves (fee, $10) may be sold for propagation only.

Massachusetts: Quail reared in captivity under permit may be exported. Game may be reared in captivity under license (no fee) and sold for propagation under regulations of commissioners; deer, elk, pheasants, quail, European or gray partridge, and wild fowl may be reared in captivity under license (no fee) and sold for food, when properly tagged. Tag fee, 5 cents. Licensed dealers may sell such game.

Michigan: Deer, elk, pheasants, and wild ducks may be raised in captivity under $5 license and sold at any time for breeding or stocking purposes and the carcasses transported or sold for food when properly tagged (fee, 5 cents). Ducks killed by shooting (except under direct supervision of a deputy warden) may not be sold or disposed of. Licensed retail dealer, club, hotel, restaurant, etc., may sell portion of tagged game to patron or customer for actual consumption or use without additional license.

Minnesota: Game raised in captivity under license (fee, 50 cents for each big-game animal) may be sold at any time—game animals under a permit and birds under a tag. Domesticated big game may be exported under permit.

Missouri: Deer and elk raised in captivity under license (fee, $5) may be transported and sold under regulations of the commissioner.

Nevada: Game raised in licensed preserve (fee, $10) may be sold or shipped at any time under invoice.

New Hampshire: Game raised in captivity under $2 license may be sold or transported at any time when properly tagged, under regulations of commissioner.

New Jersey: Deer raised in licensed preserve may be killed at any time. Deer, introduced pheasants, and mallard, black, and wood ducks raised in inclosed licensed preserve, if properly tagged, may be sold for food or exported for sale, if shipped open to view. Tag fee, 5 cents. Live deer, on payment of $5 for each animal, and game birds may be exported for propagation. Breeder's license fee, $5.

New Mexico: Game raised in licensed preserve may be exported or sold at any time.

New York: Elk, white-tailed deer, European red deer, fallow deer, roebuck, pheasants, mallard, and black ducks raised in captivity under license may be sold for breeding purposes and may be killed, sold, or exported at any time under license when properly tagged. Said ducks may be killed by shooting during open season only, but ducks killed by shooting may not be sold, except under regulations of commission. Varying hares and cottontail rabbits bred in captivity under $5 license may be sold for food during close season, when properly tagged, under rules and regulations of the conservation department.

North Carolina: Twenty-two counties have laws in regard to certain game raised in captivity.

North Dakota: Board may issue permits to breed or domesticate game.

Ohio: English ring-neck, Mongolian, or Chinese pheasants may be bred in captivity under 50-cent permit, and when killed may be sold or shipped if tagged with a distinctive metal tag. Packages for shipment must be labeled to show contents. Game birds and squirrels may be kept in inclosures for domestication.

Oklahoma: Game raised under license (fee, $2) may be transported for propagation at any time, and for food, when properly tagged, during season prescribed by commissioner.

Oregon: Game birds and animals raised in captivity under permit (fee, $2), may be exported or sold at any time upon being properly tagged by commissioner or deputy. Tag fee, 5 cents each. Packages containing game to be plainly labeled.

Pennsylvania: Game breeder's certificate, fee $1, bond $500. Game raised in captivity may be sold alive or dead within the State.

Rhode Island: Game raised in captivity under permit may be sold at any time for propagation, under regulations of commissioners.

South Carolina: Any birds or animals protected by law may be kept in possession for purposes of propagation or domestication.

South Dakota: Game raised in captivity may be exported or sold under written permission of State game warden.

Vermont: Game raised in licensed private preserves (fee, $2) may be exported at any time when duly marked and tagged, and may be sold for propagation at any time, or for food, under tag in accordance with regulations of commissioner.

Washington: Game birds raised in captivity may be exported under permit from State warden or county game commission and sold at any time for propagation only.

West Virginia: The owner of elk kept in inclosure may kill them at any time, and may pursue and recapture, by killing or otherwise, elk which have escaped from his inclosure. Tame deer may be killed by the owner.

Wisconsin: Under permit and supervision of the commission wild animals may be taken and transported for propagation within the State.

Wyoming: Natural increase of big game (except moose) captured under permit (fee, $1) and held for propagation may be exported or sold.

NEW LAWS PASSED IN 1918.

(For correct seasons for hunting migratory birds and other game see "Summary of Laws Relating to Seasons, Licenses, etc.," pp. 6–44.)

Federal.—One act: A most comprehensive and far-reaching measure (Pub. No. 186) to give effect to the treaty between the United States and Great Britain for the protection of migratory birds in the United States and Canada. The bill passed the House June 27 and the Senate June 28 and became a law on approval of the President July 3, 1918. With appropriate legislation recently enacted by the Dominion Government to give effect to the treaty in Canada, it will afford all species of migratory birds full measure of protection throughout the greater part of the North American continent.

The act makes it unlawful to capture, kill, possess, buy, sell, transport, or carry any migratory bird defined in the treaty (see p. 57), or nest or egg thereof, except as specifically permitted by regulations adopted by the Secretary of Agriculture and approved by the President of the United States, and imposes severe penalties for violations of its provisions. (Full text of the law pp. 56–58.)

The Secretary of Agriculture adopted regulations, which became effective July 31, 1918, when approved by the President, permitting and governing the capture, killing, possession, sale, purchase, shipment, transportation, and carriage of migratory birds and their nests and eggs. The open seasons prescribed by the regulations limit the hunting of migratory birds to a period not exceeding three and one-half months between September 1 and January 31, except that the hunting of black-bellied and golden plovers, and greater and lesser yellowlegs begins August 16 and closes November 30 in those States bordering on the Atlantic Ocean and situated wholly or in part north of Chesapeake Bay.

Other outstanding features are provisions for: (1) Uniform bag limits throughout the United States; (2) prohibiting the sale of all migratory birds, except for scientific and propagating purposes under permits duly issued by the Secretary of Agriculture; (3) limiting the transportation or carriage of migratory game birds to not more than two days' bag limit in any one calendar week; (4) taking migratory birds under permit for scientific purposes: (5) permits issued by the Secretary of Agriculture to kill any species of migratory bird that may under extraordinary conditions become seriously injurious to agricultural or other interests; and (6) allowing, under permits, the breeding of wild waterfowl on farms and preserves and the sale of birds so reared for the purpose of increasing the food supply. (For full text of the regulations see pp. 59–65.)

Georgia.—No game legislation.

Kentucky.—No game legislation.

Louisiana.—Three acts: Adopting seasons on migratory birds to conform with Federal regulations and prohibiting hunting except from half an hour before sunrise to sunset; lengthening the season two weeks on squirrels and bears; placing turkey hens on the game list after a closed season of six years and extending the open season on turkeys through the month of March and fixing the dove season from September 16 to December 31, instead of November 1 to February 15; permitting the sale of waterfowl, rails, coots, and snipe during the months of December and January (inoperative, as Federal regulations prohibit the sale of migratory birds); reducing bag limits on certain migratory birds, thus making State limits practically conform with those prescribed by Federal regulations; placing killdeer on the nongame bird list and protecting woodcock for five years.

Maryland.—Eleven acts: Creating a State-wide hunting-license law, a game protective fund, providing for the appointment of game wardens, and the payment of their salaries and expenses out of the game fund, increasing salary of State game warden from $1,200 to $1,800 and reducing amount to be used for his travel expenses from $600 to $500, making sheriffs, constables, and police officers ex officio game wardens; prohibiting aliens from hunting or possessing firearms, requiring written permission to hunt on land of another, and authorizing State game warden to pay from the game fund a bounty of 50 cents each on bird hawks or chicken hawks (H. 24); amending the definition of game birds to include doves throughout State (H. 328); making it unlawful to kill without consent of owner game kept in an inclosure for propagating purposes or to destroy any such inclosure (H. 101); closing season on ringneck or English pheasants in Baltimore County until June 1, 1920 (H. 97); changing seasons on certain game in Dorchester County (H. 202); removing protection from turkey buzzards within limits of incorporated towns in Caroline and Talbot Counties (H. 222); providing a special season for woodcock in Anne Arundel County (which, however, contravenes the Federal regulations) (H. 602); two acts making it unlawful to kill or expose for sale, transport, or have in possession partridge or quail, woodcock, or rabbits killed in Wicomico and Charles Counties except for consumption within the counties, prohibiting the export of such game, except by nonresident licensee lawfully killing same, and legalizing sale direct to consumers within the counties by persons killing it (sale of migratory birds prohibited under Federal regulations) (H. 496 and H. 558); permitting training of dogs from October 25 to November 9, and prohibiting hunting on Sunday or while snow is on the ground in Dorchester County (H. 369); protecting introduced pheasants and ruffed grouse in Dorchester County until 1920 (S. 486).

Massachusetts.—One resolution: Recommending a later season on waterfowl under Federal regulations (H. 538).

Mississippi.—No game legislation.

New Jersey.—Eight acts: Authorizing registrars of licenses to issue hunting and fishing licenses (ch. 34); closing season on wood duck until October 1, 1921 (ch. 60); making it unlawful to hunt game from an automobile or by aid of lights carried on an automobile (ch. 114); fixing fiscal year from July 1 to June 30 (ch. 144); relating to funds of State; providing for safeguarding receipts of board (ch. 153); providing that after complaint and investigation permits may be issued to kill deer causing damage to crops, and prescribing a penalty of $100 for failure to report to board within 48 hours the killing of such deer (ch. 154); authorizing the purchase of additional land adjoining game farm at Forked River at a cost not to exceed $5,000 (ch. 156); removing protection from the starling (ch. 241); adding three men to the warden service of the State and increasing salaries of chief protector, assistants, and wardens, $300 each in the aggregate, the increase being apportioned over four years of service (ch. 277).

New York.—Seven acts: Two bills changing title of "Division chief game protectors" to "Inspectors" and of "Fisheries protectors" and "Protector for the St. Lawrence River" to "Game protectors"; abolishing the system of paying special protectors one-half of fine (A. 285 and 455); increasing salaries of inspectors from $1,600 to $1,800 and salaries of protectors from $950 to $1,000, with a maximum under merit system of $1,500 instead of $1,300 for those in first grade and establishing a maximum of $1,300 for those in the second grade (A. 286); continuing closed season on quail for two years to October 1, 1920 (ch. 281); authorizing the attorney general to defend employees of commission in suits growing out of the discharge of their duties (ch. 68); authorizing the destruction of cats found hunting or killing any protected bird or with a dead bird in possession (A. 1074); repealing local law for rabbits on Long Island and extending open season for State from October 1 to January 31, to October 1 to March 1 (ch. 144); providing that wild fowl shall only be taken with a shotgun, except in counties wholly or partly within the forest preserve or on Long Island (ch. 290).

Rhode Island.—Two acts: Authorizing the establishment of State game reservations on private lands by lease or with consent of owner (S. 70); prohibiting possession of more than 15 protected birds at any one time (S. 71).

South Carolina.—Five acts: Providing special seasons on quail and squirrels in Greenwood County; relating to seasons on deer and certain game birds in Beaufort, Chester, and Jasper Counties; relating to seasons in Greenville County; relating to seasons on quail and squirrels in McCormick County; and removing protection from buzzards in State.

Virginia.—Three general and thirteen local laws: Authorizing boards of supervisors of any county to pay bounties of 50 cents each for scalps of goshawks and Cooper hawks killed in county (ch. 23); authorizing board of supervisors of Fauquier County to pay bounty of 50 cents each for scalps of goshawks and Cooper hawks killed in county (ch. 35); authorizing board of supervisors of Rockingham County to pay bounty on crows (ch. 201); repealing previous act making it unlawful to hunt sora with lights at night in marshes of Mattaponi River (ch. 129) (Federal regulations prohibit killing or capture of sora and other migratory birds from sunset to half an hour before sunrise); repealing previous act prohibiting killing of deer in Buckingham County for five years (ch. 132); prohibiting killing for sale of rabbits in Madison County (ch. 142); fixing season on squirrels in Loudoun County June 1–October 31 (ch. 168); closing season on ringneck pheasants in Brunswick County to November 1, 1921 (ch. 181); protecting deer for three years and elk for five years in counties of Botetourt, Bland, Allegheny, Giles, Montgomery, Craig, Pulaski, Russell, Rockbridge, Franklin, Rockingham, Wythe, and Patrick (ch. 194); fixing the open season on squirrels in Rappahannock County from November 1–January 31 (ch. 196); opening the season on deer in Cumberland County (ch. 197); prohibiting hunting on ponds, lakes, and streams supplying water to cities having a population of over 19,000 (Danville, Lynchburg, Newport News, Norfolk, Petersburg, Portsmouth, Richmond, and Roanoke) (ch. 244); authorizing the appointment of special wardens for a period of five days during each of the months of October, November, December, and January at a per diem of $2.50; conferring on nonresidents additional privilege of hunting without license on land adjoining their own and giving same privilege to their sons; and increasing fees of clerks issuing licenses (ch. 259); regulating propagation and sale of game and prescribing licenses therefor (ch. 266); fixing season on wild turkey, pheasant, grouse, quail, woodcock, squirrels, and rabbits from November 1–January 31, and the season on deer from November 1–December 31, prohibiting sale of above game, and hunting when snow is on the ground in Amelia and Nottoway Counties (ch. 299) (Federal regulations prohibit killing of woodcock except during November and December); prescribing daily bag limit of not more than 15 quail and 2 turkeys in Brunswick County (ch. 320).

CANADA.

Dominion legislation.—One regulation, one act: Comprehensive regulations were promulgated May 11, 1918, by the Canadian Government to give effect to the migratory birds convention act of 1917, prohibiting all hunting of migratory birds after January 15 and before September 1, except shorebirds in maritime Provinces, where the season opens August 15, all open seasons being restricted to a period not exceeding three and one-half months. Act revising and amending the game laws for the Northwest Territories by lengthening the season two weeks on deer, moose, and goats, and shortening it two weeks on caribou and sheep; prohibiting the hunting of buffalo and musk-ox, and protecting elk or wapiti, except in such zones and during such periods as the governor-in-council may prescribe; prescribing licenses, resident hunting and trapping, fee $2; trading in game, fee $5; nonresident license fees, bag limits, and transportation regulated by governor-in-council (ch. 36, act of Sept. 20, 1917).

Alberta.—One act: Opening the season on grouse and Hungarian partridge during the month of October, and establishing two game preserves, one in Cypress Hills and the other in the Cooking Lake Forest Reserve.

British Columbia.—One act: Comprehensive law reenacting and amending Provincial game code; reorganizing the game department and placing it in charge of a game conservation board of three members; reducing the limit on moose from two to one and on caribou and goats from three each to two each a season; reducing the fee for a nonresident general license from $100 to $25, but requiring an additional fee ranging from $5 to $25 for each head of big game taken by a nonresident.

Manitoba.—One act: Changing nonresident license fee of $50 for all game to $25 for big game and $25 for birds; and prescribing a special $10 bird license to nonresident British.

New Brunswick.—Two acts: Repealing Provincial legislation on migratory birds (ch. 21); protecting caribou and partridge until 1921, making sheriffs, licensed guides, holders of game licenses, labor-act commissioners, and inspectors under intoxicating-liquor act ex-officio game wardens, requiring applicant for license to make oath that he will observe the game laws, and prohibiting sale of deer and moose, except head or hide.

Nova Scotia.—One act: Continuing indefinitely the close seasons expiring in 1918 on moose and deer on Cape Breton Island and on caribou and cow moose throughout Province; protecting ruffed grouse or birch partridge until 1922; fixing season on plover and yellowlegs and protecting swans, wood duck, eider ducks, and the smaller shorebirds in harmony with the migratory-bird treaty.

Ontario.—One act: Extending the open season 10 days on moose and caribou by opening October 1 instead of October 10; extending the close term on all grouse until 1920; protecting swans and wood and eider ducks, band-tailed pigeons, cranes, and the smaller shorebirds, and prohibiting spring shooting, by adopting seasons on waterfowl, plover, snipe, and yellowlegs in conformity with the migratory-bird treaty; extending the season until March 31 during which lawfully killed game may be possessed; increasing the fee for a resident deer license from $2 to $3, and permitting a resident to take two deer a season; and authorizing the minister to remit any part of fines in excess of $200 for offenses committed at the same time or included in the same conviction.

Quebec.—One act: Making seasons on waterfowl, coot, and rails in conformity with the migratory-bird treaty, protecting eider ducks at all times, and permitting Indians to take waterfowl and their eggs for food and their skins for clothing, but prohibiting the sale of birds and eggs taken for such purposes; and protecting at all times migratory insectivorous and perching birds.

LACEY ACT, REGULATING INTERSTATE COMMERCE IN GAME.

Federal laws affecting the shipment of game comprise statutes regulating interstate commerce in game and the importation of birds and mammals from foreign countries, as follows:

ACT OF MARCH 4, 1909.

(35 Stat., 1137.)

The importation of certain injurious animals and birds; permits for foreign wild animals and birds; cage birds, specimens for museums, etc.

SEC. 241. The importation into the United States, or any Territory or District thereof, of the mongoose, the so-called "flying foxes," or fruit bats, the English sparrow, the starling, and such other birds and animals as the Secretary of Agriculture may from time to time declare to be injurious to the interests of agriculture or horticulture, is hereby prohibited; and all such birds and animals shall, upon arrival at any port of the United States, be destroyed or returned at the expense of the owner. No person shall import into the United States or into any Territory or District thereof any foreign wild animal or bird, except under special permit from the Secretary of Agriculture: *Provided*, That nothing in this section shall restrict the importation of natural-history specimens for museums or scientific collections, or of certain cage birds, such as domesticated canaries, parrots, or such other birds as the Secretary of Agriculture may designate. The Secretary of the Treasury is hereby authorized to make regulations for carrying into effect the provisions of this section.

Interstate transportation of animals and birds illegally imported and game killed or shipped in violation of State laws; transportation of game in season; feathers of barnyard fowls.

SEC. 242. It shall be unlawful for any person to deliver to any common carrier for transportation, or for any common carrier to transport from any State, Territory, or District of the United States to any other State, Territory, or District thereof, any foreign animals or birds the importation of which is prohibited, or the dead bodies or parts thereof of any wild animals or birds, where such animals or birds have been killed or shipped in violation of the laws of the State, Territory, or District in which the same were killed, or from which they were shipped: *Provided*, That nothing herein shall prevent the transportation of any dead birds or animals killed during the season when the same may be lawfully captured, and the export of which is not prohibited by law in the State, Territory, or District in which the same are captured or killed: *Provided further*, That nothing herein shall prevent the importation, transportation, or sale of birds or bird plumage manufactured from the feathers of barnyard fowls.

Marking of packages containing bodies or plumage of game animals or game or other wild birds.

SEC. 243. All packages containing the dead bodies, or the plumage, or parts thereof, of game animals, or game or other wild birds, when shipped in interstate or foreign commerce, shall be plainly and clearly marked, so that the name and address of the shipper, and the nature of the contents, may be readily ascertained on an inspection of the outside of such package.

Penalty for violations of sections 241 to 244.

Sec. 244. For each evasion or violation of any provision of the three sections last preceding, the shipper shall be fined not more than $200; the consignee knowingly receiving such articles so shipped and transported in violation of said sections shall be fined not more than $200; and the carrier knowingly carrying or transporting the same in violation of said sections shall be fined not more than $200.

SECTIONS 1 AND 5—ACT OF MAY 25, 1900.

(31 Stat., 187-8.)

Preservation, distribution, introduction, and restoration of game birds and other wild birds; collection and publication of information as to propagation, uses, and preservation of such birds; regulation for carrying out purposes of act.

That the duties and powers of the Department of Agriculture are hereby enlarged so as to include the preservation, distribution, introduction, and restoration of game birds and other wild birds. The Secretary of Agriculture is hereby authorized to adopt such measures as may be necessary to carry out the purposes of this act and to purchase such game birds and other wild birds as may be required therefor, subject, however, to the laws of the various States and Territories. The object and purpose of this act is to aid in the restoration of such birds in those parts of the United States adapted thereto where the same have become scarce or extinct, and also to regulate the introduction of American or foreign birds or animals in localities where they have not heretofore existed.

The Secretary of Agriculture shall from time to time collect and publish useful information as to the propagation, uses, and preservation of such birds.

And the Secretary of Agriculture shall make and publish all needful rules and regulations for carrying out the purposes of this act, and shall expend for said purposes such sums as Congress may appropriate therefor.

Bodies of game animals and game and song birds subject to laws of State, etc., into which transported.

Sec. 5. That all dead bodies, or parts thereof, of any foreign game animals, or game or song birds, the importation of which is prohibited, or the dead bodies, or parts thereof, of any wild game animals, or game or song birds transported into any State or Territory, or remaining therein for use, consumption, sale, or storage therein, shall upon arrival in such State or Territory be subject to the operation and effect of the laws of such State or Territory enacted in the exercise of its police powers, to the same extent and in the same manner as though such animals or birds had been produced in such State or Territory, and shall not be exempt therefrom by reason of being introduced therein in original packages or otherwise. This act shall not prevent the importation, transportation, or sale of birds or bird plumage manufactured from the feathers of barnyard fowl.

TARIFF ACT, PROHIBITING IMPORTATION OF PLUMAGE.

ACT OF OCTOBER 3, 1913.

(38 Stat., 148.)

PAR. 347. Feathers and downs, on the skin or otherwise, crude or not dressed, colored, or otherwise advanced or manufactured in any manner, not specially provided for in this section, twenty per centum ad valorem; when dressed, colored, or otherwise advanced or manufactured in any manner, and not suitable for use as millinery ornaments, including quilts of down and manufactures of down, forty per centum ad valorem; artificial or ornamental feathers suitable for use as millinery ornaments, artificial and ornamental fruits, grains, leaves, flowers, and stems or parts thereof, of whatever material composed, not specially provided for in this section, sixty per centum ad valorem; boas, boutonnières, wreaths, and all articles not specially provided for in this section, composed wholly or in chief value of any of the feathers, flowers, leaves, or other material herein mentioned, sixty per centum ad valorem: *Provided*, That the importation of aigrettes, egret plumes or so-called osprey plumes, and the feathers, quills, heads, wings, tails, skins, or parts of skins, of wild birds, either raw or manufactured, and not for scientific or educational purposes, is hereby prohibited; but this provision shall not apply to the feathers or plumes of ostriches, or to the feathers or plumes of domestic fowls of any kind.

LAW PROTECTING BIRDS AND THEIR EGGS ON FEDERAL BIRD RESERVATIONS.

ACT OF MARCH 4, 1909.

(35 Stat., 1104.)

SEC. 84. Whoever shall hunt, trap, capture, willfully disturb, or kill any bird of any kind whatever, or take the eggs of any such bird, on any lands of the United States which have been set apart or reserved as breeding grounds for birds, by any law, proclamation, or Executive order, except under such rules and regulations as the Secretary of Agriculture may, from time to time, prescribe, shall be fined not more than $500, or imprisoned not more than six months, or both.

CONVENTION BETWEEN THE UNITED STATES AND GREAT BRITAIN FOR THE PROTECTION OF MIGRATORY BIRDS IN THE UNITED STATES AND CANADA.[1]

[Proclaimed December 8, 1916.]

WHEREAS many species of birds in the course of their annual migrations traverse certain parts of the United States and the Dominion of Canada; and

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[1] This treaty was signed on August 16, ratified by the Senate August 29, by the President September 1, and by Great Britain October 20; ratifications thereof were exchanged December 7, and it was proclaimed by the President December 8, 1916.

Canada, by an act of Parliament approved August 29, 1917, gave full effect to this convention, and promulgated regulations thereunder May 11, 1918.

The Constitution of the United States contains the following provision in regard to treaties:

"This Constitution, and the laws of the United States which shall be made in pursuance thereof; and all treaties made, or which shall be made, under the authority of the United States shall be the supreme law of the land; and the judges in every State shall be bound thereby, anything in the constitution or laws of any State to the contrary notwithstanding." (Art. VI, par. 2.)

WHEREAS many of these species are of great value as a source of food or in destroying insects which are injurious to forests and forage plants on the public domain, as well as to agricultural crops, in both the United States and Canada, but are nevertheless in danger of extermination through lack of adequate protection during the nesting season or while on their way to and from their breeding grounds;

The United States of America and His Majesty the King of the United Kingdom of Great Britain and Ireland and of the British dominions beyond the seas, Emperor of India, being desirous of saving from indiscriminate slaughter and of insuring the preservation of such migratory birds as are either useful to man or are harmless, have resolved to adopt some uniform system of protection which shall effectively accomplish such objects, and to the end of concluding a convention for this purpose have appointed as their respective plenipotentiaries:

The President of the United States of America, Robert Lansing, Secretary of State of the United States; and

His Britannic Majesty, the Right Honorable Sir Cecil Arthur Spring Rice, G. C. V. O., K. C. M. G., etc., His Majesty's ambassador extraordinary and plenipotentiary at Washington;

Who, after having communicated to each other their respective full powers, which were found to be in due and proper form, have agreed to and adopted the following articles:

ARTICLE I.

The High Contracting Powers declare that the migratory birds included in the terms of this convention shall be as follows:

1. Migratory game birds:

(*a*) Anatidae, or waterfowl, including brant, wild ducks, geese, and swans.

(*b*) Gruidae, or cranes, including little brown, sandhill, and whooping cranes.

(*c*) Rallidae, or rails, including coots, gallinules, and sora, and other rails.

(*d*) Limicolae, or shore birds, including avocets, curlew, dowitchers, godwits, knots, oyster catchers, pharlaropes, plovers, sandpipers, snipe, stilts, surf birds, turnstones, willet, woodcock, and yellowlegs.

(*e*) Columbidae, or pigeons, including doves and wild pigeons.

2. Migratory insectivorous birds: Bobolinks, catbirds, chickadees, cuckoos, flickers, flycatchers, grosbeaks, humming birds, kinglets, martins, meadowlarks, nighthawks or bull bats, nut-hatches, orioles, robins, shrikes, swallows, swifts, tanagers, titmice, thrushes, vireos, warblers, waxwings, whippoorwills, woodpeckers, and wrens, and all other perching birds which feed entirely or chiefly on insects.

3. Other migratory nongame birds: Auks, auklets, bitterns, fulmars, gannets, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, and terns.

ARTICLE II.

The High Contracting Powers agree that, as an effective means of preserving migratory birds, there shall be established the following close seasons during which no hunting shall be done except for scientific or propagation purposes under permits issued by proper authorities.

1. The close season on migratory game birds shall be between March 10 and September 1, except that the close season on the Limicolae, or shore birds, in the maritime Provinces of Canada and in those States of the United States bordering on the Atlantic Ocean which are situated wholly or in part north of Chesapeake Bay shall be between February 1 and August 15, and that Indians may take at any time scoters for food but not for sale. The season for hunting shall be further restricted to such period not exceeding three and one-half months as the High Contracting Powers may severally deem appropriate and define by law or regulation.

2. The close season on migratory insectivorous birds shall continue throughout the year.

3. The close season on other migratory nongame birds shall continue throughout the year, except that Eskimos and Indians may take at any season auks, auklets, guillemots, murres, and puffins, and their eggs, for food and their skins for clothing, but the birds and eggs so taken shall not be sold or offered for sale.

ARTICLE III.

The High Contracting Powers agree that during the period of 10 years next following the going into effect of this convention there shall be a continuous close season on the following migratory game birds, to wit:

Band-tailed pigeons; little brown, sandhill, and whooping cranes, swans, curlew and all shorebirds (except the black-breasted and golden plover, Wilson or jacksnipe, woodcock, and the greater and lesser yellowlegs); provided, that during such 10 years the close seasons on cranes, swans, and curlew in the Province of British Columbia shall be made by the proper authorities of that Province within the general dates and limitations elsewhere prescribed in this convention for the respective groups to which these birds belong.

ARTICLE IV.

The High Contracting Powers agree that special protection shall be given the wood duck and the eider duck, either (1) by a close season extending over a period of at least five years, or (2) by the establishment of refuges, or (3) by such other regulations as may be deemed appropriate.

ARTICLE V.

The taking of nests or eggs of migratory game or insectivorous or nongame birds shall be prohibited except for scientific or propagating purposes, under such laws or regulations as the High Contracting Powers may severally deem appropriate.

ARTICLE VI.

The High Contracting Powers agree that the shipment or export of migratory birds or their eggs from any State or Province, during the continuance of the close season in such State or Province, shall be prohibited except for scientific or propagating purposes, and the international traffic in any birds or eggs at such time captured, killed, taken, or shipped at any time contrary to the laws of the State or Province in which the same were captured, killed, taken, or shipped shall be likewise prohibited. Every package containing migratory birds or any parts thereof or any eggs of migratory birds transported, or offered for transportation from the Dominion of Canada into the United States or from the United States into the Dominion of Canada, shall have the name and address of the shipper and an accurate statement of the contents clearly marked on the outside of such package.

ARTICLE VII.

Permits to kill any of the above-named birds which, under extraordinary conditions, may become seriously injurious to the agricultural or other interests in any particular community, may be issued by the proper authorities of the High Contracting Powers under suitable regulations prescribed therefor by them respectively, but such permits shall lapse, or may be canceled, at any time when, in the opinion of said authorities, the particular exigency has passed, and no birds killed under this article shall be shipped, sold, or offered for sale.

ARTICLE VIII.

The High Contracting Powers agree themselves to take, or propose to their respective appropriate law-making bodies, the necessary measures for insuring the execution of the present convention.

ARTICLE IX.

The present convention shall be ratified by the President of the United States of America, by and with the advice and consent of the Senate thereof, and by His Britannic Majesty. The ratifications shall be exchanged at Washington as soon as possible and the convention shall take effect on the date of the exchange of the ratifications. It shall remain in force for 15 years, and in the event of neither of the High Contracting Powers having given notification, 12 months before the expiration of said period of 15 years, of its intention of terminating its operation, the convention shall continue to remain in force for one year and so on from year to year.

In faith whereof, the respective Plenipotentiaries have signed the present convention in duplicate and have hereunto affixed their seals.

Done at Washington this 16th day of August, 1916.

[SEAL.] ROBERT LANSING.
[SEAL.] CECIL SPRING RICE.

MIGRATORY BIRD TREATY ACT.

[Approved July 3, 1918. Public, No. 186, 65th Congress—S. 1553.]

AN ACT To give effect to the convention between the United States and Great Britain for the protection of migratory birds concluded at Washington, August sixteenth, nineteen hundred and sixteen, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act shall be known by the short title of the "Migratory Bird Treaty Act."

SEC. 2. That unless and except as permitted by regulations made as hereinafter provided, it shall be unlawful to hunt, take, capture, kill, attempt to take, capture, or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time or in any manner, any migratory bird, included in the terms of the convention between the United States and Great Britain for the protection of migratory birds concluded August sixteenth, nineteen hundred and sixteen, or any part, nest, or egg of any such birds.

SEC. 3. That subject to the provisions and in order to carry out the purposes of the convention, the Secretary of Agriculture is authorized and directed, from time to time, having due regard to the zones of temperature and to the distribution, abundance, economic value, breeding habits, and times and lines of migratory flight of such birds, to determine when, to what extent, if at all, and by what means, it is compatible with the terms of the convention to allow hunting, taking, capture, killing, possession, sale, purchase, shipment, transportation, carriage, or export of any such bird, or any part, nest, or egg thereof, and to adopt suitable regulations permitting and governing the same, in accordance with such determinations, which regulations shall become effective when approved by the President.

SEC. 4. That it shall be unlawful to ship, transport, or carry, by any means whatever, from one State, Territory, or District to or through another State, Territory, or District, or to or through a foreign country, any bird, or any part, nest, or egg thereof, captured, killed, taken, shipped, transported, or carried at any time contrary to the laws of the State, Territory, or District in which it was captured, killed, or taken, or from which it was shipped, transported, or carried. It shall be unlawful to import any bird, or any part, nest, or egg thereof, captured, killed, taken, shipped, transported, or carried contrary to the laws of any Province of the Dominion of Canada in which the same was captured, killed, or taken, or from which it was shipped, transported, or carried.

SEC. 5. That any employee of the Department of Agriculture authorized by the Secretary of Agriculture to enforce the provisions of this act shall have power, without warrant, to arrest any person committing a violation of this act in his presence or view and to take such person immediately for examination or trial before an officer or court of competent jurisdiction; shall have power to execute any warrant or other process issued by an officer or court of competent jurisdiction for the enforcement of the provisions of this act; and shall have authority, with a search warrant, to search any place. The several judges of the courts established under the laws of the United States, and United States commissioners may, within their respective jurisdictions, upon proper oath or affirmation showing probable cause, issue warrants in all such cases. All birds, or parts, nests, or eggs thereof, captured, killed, taken, shipped, transported, carried, or possessed contrary to the provisions of this act or of any regulations made pursuant thereto shall, when found, be seized by any such employee, or by any marshal or deputy marshal, and upon conviction of the offender or upon judgment of a court of the United States that the same were captured, killed, taken, shipped, transported, carried, or possessed contrary to the provisions of this act or of any regulation made pursuant thereto, shall be forfeited to the United States and disposed of as directed by the court having jurisdiction.

SEC. 6. That any person, association, partnership, or corporation who shall violate any of the provisions of said convention or of this act, or who shall violate or fail to comply with any regulation made pursuant to this act, shall be deemed guilty of a misdemeanor and upon conviction thereof shall be fined not more than $500 or be imprisoned not more than six months, or both.

SEC. 7. That nothing in this act shall be construed to prevent the several States and Territories from making or enforcing laws or regulations not inconsistent with the provisions of said convention or of this act, or from making or enforcing laws or regulations which shall give further protection to migratory birds, their nests, and eggs, if such laws or regulations do not extend the open season for such birds beyond the dates approved by the President in accordance with section three of this act.

SEC. 8. That until the adoption and approval, pursuant to section three of this act, of regulations dealing with migratory birds and their nests and eggs, such migratory birds and their nests and eggs as are intended and used exclusively for scientific or propagating purposes may be taken, captured, killed, possessed, sold, purchased, shipped, and transported for such scientific or propagating purposes if and to the extent not in conflict with the laws of the State, Territory, or District in which they are taken, captured, killed, possessed, sold, or purchased, or in or from which they are shipped or transported if the packages containing the dead bodies or the nests or eggs of such birds when shipped and transported shall be marked on the outside thereof so as accurately and clearly to show the name and address of the shipper and the contents of the package.

SEC. 9. That the unexpended balances of any sums appropriated by the agricultural appropriation acts for the fiscal years nineteen hundred and seventeen and nineteen hundred and eighteen, for enforcing the provisions of the act approved March fourth, nineteen hundred and thirteen, relating to the protection of migratory game and insectivorous birds, are hereby reappropriated and made available until expended for the expenses of carrying into effect the provisions of this act and regulations made pursuant thereto, including the payment of such rent, and the employment of such persons and means, as the Secretary of Agriculture may deem necessary, in the District of Columbia and elsewhere, cooperation with local authorities in the protection of migratory birds, and necessary investigations connected therewith: *Provided*, That no person who is subject to the draft for service in the Army or Navy shall be exempted or excused from such service by reason of his employment under this act.

SEC. 10. That if any clause, sentence, paragraph, or part of this act shall for any reason, be adjudged by any court of competent jurisdiction to be invalid, such judgment shall not affect, impair, or invalidate the remainder thereof, but shall be confined in its operation to the clause, sentence, paragraph, or part thereof directly involved in the controversy in which such judgment shall have been rendered.

SEC. 11. That all acts or parts of acts inconsistent with the provisions of this act are hereby repealed.

SEC. 12. Nothing in this act shall be construed to prevent the breeding of migratory game birds on farms and preserves and the sale of birds so bred under proper regulations for the purpose of increasing the food supply.

SEC. 13. That this act shall become effective immediately upon its passage and approval.

MIGRATORY BIRD TREATY ACT REGULATIONS.

[Effective July 31, 1918.]

BY THE PRESIDENT OF THE UNITED STATES OF AMERICA.

A PROCLAMATION.

WHEREAS, section three of the act of Congress approved July third, nineteen hundred and eighteen, entitled "An act to give effect to the convention between the United States and Great Britain for the protection of migratory birds concluded at Washington, August sixteenth, nineteen hundred and sixteen, and for other purposes" (Public, No. 186, 65th Congress), provides as follows:

> That subject to the provisions and in order to carry out the purposes of the convention, the Secretary of Agriculture is authorized and directed, from time to time, having due regard to the zones of temperature and to the distribution, abundance, economic value, breeding habits, and times and lines of migratory flight of such birds, to determine when, to what extent, if at all, and by what means, it is compatible with the terms of the convention to allow hunting, taking, capture, killing, [possession, (sic)], sale, purchase, shipment, transportation, carriage, or export of any such bird, or any part, nest, or egg thereof, and to adopt suitable regulations permitting and governing the same, in accordance with such determinations, which regulations shall become effective when approved by the President.

AND, WHEREAS, The Secretary of Agriculture, pursuant to said section and having due regard to the zones of temperature and to the distribution, abundance, economic value, breeding habits, and times and lines of migratory flight of migratory birds included in the terms of the convention between the United States and Great Britain for the protection of migratory birds concluded August sixteenth, nineteen hundred and sixteen, has determined when, to what extent, and by what means it is compatible with the terms of said convention to allow hunting, taking, capture, killing, possession, sale, purchase, shipment, transportation, carriage, and export of such birds and parts thereof, and their nests and eggs, and in accordance with such determinations has adopted and submitted to me for approval regulations, which the Secretary of Agriculture has determined to be suitable regulations, permitting and governing hunting, taking, capture, killing, possession, sale, purchase, shipment, transportation, carriage, and export of said birds and parts thereof and their nests and eggs, which said regulations are as follows:

REGULATIONS, MIGRATORY BIRD TREATY ACT.

REGULATION 1.—DEFINITIONS OF MIGRATORY BIRDS.

Migratory birds, included in the terms of the convention between the United States and Great Britain for the protection of migratory birds, concluded August 16, 1916, are as follows:

1. *Migratory game birds:*

(*a*) Anatidae, or waterfowl, including brant, wild ducks, geese, and swans.

(*b*) Gruidae, or cranes, including little brown, sandhill, and whooping cranes.

(*c*) Rallidae, or rails, including coots, gallinules, and sora and other rails.

(*d*) Limicolae, or shorebirds, including avocets, curlews, dowitchers, godwits, knots, oyster catchers, phalaropes, plovers, sandpipers, snipe, stilts, surf birds, turnstones, willet, woodcock, and yellowlegs.

(*e*) Columbidae, or pigeons, including doves and wild pigeons.

2. *Migratory insectivorous birds:* Bobolinks, catbirds, chickadees, cuckoos, flickers, flycatchers, grosbeaks, hummingbirds, kinglets, martins, meadowlarks, nighthawks or bull-bats, nuthatches, orioles, robins, shrikes, swallows, swifts, tanagers, titmice, thrushes, vireos, warblers, waxwings, whip-poor-wills, woodpeckers, and wrens, and all other perching birds which feed entirely or chiefly on insects.

3. *Other migratory nongame birds:* Auks, auklets, bitterns, fulmars, gannets, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, and terns.

REGULATION 2.—DEFINITIONS OF TERMS.

For the purposes of these regulations the following terms shall be construed, respectively, to mean—

Secretary.—The Secretary of Agriculture of the United States.

Person.—The plural or the singular, as the case demands, including individuals, associations, partnerships, and corporations, unless the context otherwise requires.

Take.—The pursuit, hunting, capture, or killing of migratory birds in the manner and by the means specifically permitted.

Open season.—The time during which migratory birds may be taken.

Transport.—Shipping, transporting, carrying, exporting, receiving or delivering for shipment, transportation, carriage, or export.

REGULATION 3.—MEANS BY WHICH MIGRATORY GAME BIRDS MAY BE TAKEN.

The migratory game birds specified in Regulation 4 hereof may be taken during the open season with a gun only, not larger than number 10 gauge, fired from the shoulder, except as specifically permitted by Regulations 7, 8, 9, and 10 hereof; they may be taken during the open season from the land and water, from a blind or floating device (other than an airplane, powerboat, sailboat, or any boat under sail), with the aid of a dog, and the use of decoys.

REGULATION 4.—OPEN SEASONS ON AND POSSESSION OF CERTAIN MIGRATORY GAME BIRDS.

For the purpose of this regulation, each period of time herein prescribed as an open season shall be construed to include the first and last days thereof.

Waterfowl (except wood duck, eider ducks, and swans), rails, coot, gallinules, black-bellied and golden plovers, greater and lesser yellowlegs, woodcock, Wilson snipe or jacksnipe, and mourning and white-winged doves may be taken each day from half an hour before sunrise to sunset during the open seasons prescribed therefor in this regulation, by the means and in the numbers permitted by Regulations 3 and 5 hereof, respectively, and when so taken, each species may be possessed any day during the respective open seasons herein prescribed therefor and for an additional period of 10 days next succeeding said open season.

Waterfowl (except wood duck, eider ducks, and swans), coot, gallinules, and Wilson snipe or jacksnipe.—The open seasons for waterfowl (except wood duck, eider ducks, and swans), coot, gallinules, and Wilson snipe or jacksnipe shall be as follows:

In Maine, New Hampshire, Vermont, Massachusetts, New York (except Long Island). Pennsylvania, Ohio, West Virginia, Kentucky, Indiana, Michigan, Wisconsin, Illinois, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas, Colorado, Wyoming, Montana, Idaho, Nevada, and that portion of Oregon and Washington lying east of the summit of the Cascade Mountains the open season shall be from September 16 to December 31;

In Rhode Island, Connecticut, Utah, and that portion of Oregon and Washington lying west of the summit of the Cascade Mountains the open season shall be from October 1 to January 15;

In that portion of New York known as Long Island, and in New Jersey, Delaware, Oklahoma, Texas, New Mexico, Arizona, and California the open season shall be from October 16 to January 31;

In Maryland, the District of Columbia, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Tennessee, Arkansas, and Louisiana the open season shall be from November 1 to January 31; and

In Alaska the open season shall be from September 1 to December 15.

Rails (except coot and gallinules).—The open season for sora and other rails (except coot and gallinules) shall be from September 1 to November 30, except as follows:

In Louisiana the open season shall be from November 1 to January 31.

Black-bellied and golden plovers and greater and lesser yellowlegs.—The open seasons for black-bellied and golden plovers and greater and lesser yellowlegs shall be as follows:

In Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, and Virginia the open season shall be from August 16 to November 30;

In the District of Columbia, North Carolina, South Carolina, Tennessee, Arkansas, Oklahoma, New Mexico, Arizona, California, and Alaska the open season shall be from September 1 to December 15;

In Vermont, Pennsylvania, Ohio, West Virginia, Kentucky, Indiana, Michigan, Wisconsin, Illinois, Missouri, Iowa, Minnesota, North Dakota, South Dakota, Nebraska, Kansas, Colorado, Wyoming, Montana, Idaho, Nevada, and that portion of Oregon and Washington lying east of the summit of the Cascade Mountains the open season shall be from September 16 to December 31;

In Utah and in that portion of Oregon and Washington lying west of the summit of the Cascade Mountains the open season shall be from October 1 to January 15; and

In Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas the open season shall be from November 1 to January 31.

Woodcock.—The open seasons for woodcock shall be as follows:

In Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Ohio, West Virginia, Kentucky, Indiana, Michigan, Wisconsin, Illinois, Missouri, Iowa, Minnesota, North Dakota, South Dakota, Nebraska, and Kansas the open season shall be from October 1 to November 30; and

In Delaware, Maryland, the District of Columbia, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Tennessee, Arkansas, Louisiana, Texas, and Oklahoma the open season shall be from November 1 to December 31.

Doves.—The open seasons for mourning and white-winged doves shall be as follows:

In Delaware, Maryland, Virginia, Tennessee, Kentucky, Illinois, Missouri, Oklahoma, Texas, New Mexico, Colorado, Arizona, California, Nevada, Idaho, and Oregon the open season shall be from September 1 to December 15; and

In North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, and Louisiana, the open season shall be from September 16 to December 31.

REGULATION 5.—BAG LIMITS ON CERTAIN MIGRATORY GAME BIRDS.

A person may take in any one day during the open seasons prescribed therefor in Regulation 4 not to exceed the following numbers of migratory game birds:

Ducks (*except wood duck and eider ducks*).—Twenty-five in the aggregate of all kinds.

Geese.—Eight in the aggregate of all kinds.

Brant.—Eight.

Rails, coot, and gallinules.—Twenty-five in the aggregate of all kinds.

Black-bellied and golden plovers and greater and lesser yellowlegs.—Fifteen in the aggregate of all kinds.

Wilson snipe, or jacksnipe.—Twenty-five.

Woodcock.—Six.

Doves (*mourning and white-winged*).—Twenty-five in the aggregate of both kinds.

REGULATION 6.—SHIPMENT AND TRANSPORTATION OF CERTAIN MIGRATORY GAME BIRDS.

Waterfowl (except wood duck, eider ducks, and swans), rails, coot, gallinules, black-bellied and golden plovers, greater and lesser yellowlegs, woodcock, Wilson snipe or jacksnipe, and mourning and white-winged doves and parts thereof legally taken may be transported in or out of the State where taken during the respective open seasons in that State, and may be imported from Canada during the open season in the Province where taken, in any manner, but not more by one person in one calendar week than the number that may be taken under these regulations in two days by one person; any such migratory game birds or parts thereof in transit during the open season may continue in transit such additional time immediately succeeding such open season, not to exceed five days, necessary to deliver the same to their destination; and any package in which migratory game birds or parts thereof are transported shall have the name and address of the shipper and of the consignee and an accurate statement of the numbers and kinds of birds contained therein clearly and conspicuously marked on the outside thereof; but no such birds shall be transported from any State, Territory, or District to or through another State, Territory, or District, or to or through a Province of the Dominion of Canada contrary to the laws of the State, Territory, or District or Province of the Dominion of Canada in which they were taken or from which they are transported; nor shall any such birds be transported into any State, Territory, or District from another State, Territory, or District, or from any State, Territory, or District into any Province of the Dominion of Canada at a time when such State, Territory, or District, or Province of the Dominion of Canada prohibits the possession or transportation thereof.

REGULATION 7.—TAKING OF CERTAIN MIGRATORY NONGAME BIRDS BY ESKIMOS AND INDIANS IN ALASKA.

In Alaska Eskimos and Indians may take for the use of themselves and their immediate families, in any manner and at any time, and possess and transport auks, auklets, guillemots, murres, and puffins and their eggs for food, and their skins for clothing.

REGULATION 8.—PERMITS TO PROPAGATE AND SELL MIGRATORY WATERFOWL.

1. A person may take in any manner and at any time migratory waterfowl and their eggs for propagating purposes when authorized by a permit issued by the Secretary. Waterfowl and their eggs so taken may be possessed by the permittee and may be sold and transported by him for propagating purposes to any person holding a permit issued by the Secretary in accordance with the provisions of this regulation.

2. A person authorized by a permit issued by the Secretary may possess, buy, sell, and transport migratory waterfowl and their increase and eggs in any manner and at any time for propagating purposes; and migratory waterfowl, except the birds taken under paragraph 1 of this regulation, so possessed may be killed by him in any manner except by shooting, and the unplucked carcasses and the plucked carcasses with heads attached thereto of the birds so killed may be sold and transported by him in any manner and at any time to any person for actual consumption, or to the keeper of a hotel, restaurant, or boarding house, retail dealer in meat or game, or a club, for sale or service to their patrons, who may possess such carcasses for actual consumption without a permit.

3. Any package in which such waterfowl or parts thereof or their eggs are transported shall have plainly and conspicuously marked on the outside thereof the name and address of the permittee, the number of his permit, the name and address of the consignee, and an accurate statement of the number and kinds of birds or eggs contained therein.

4. Applications for permits must be addressed to the Secretary of Agriculture, Washington, D. C., and must contain the following information: Name and address of applicant; place where the business is to be carried on; number of acres of land used in the business and whether owned or leased by the applicant; number of each species of waterfowl in possession of applicant; names of species and number of birds or eggs of each species if permission is asked to take waterfowl or their eggs; and the particular locality where it is desired to take such waterfowl or eggs.

5. A person granted a permit under this regulation shall keep books and records which shall correctly set forth the total number of each species of waterfowl and their eggs possessed on the date of application for the permit and on the first day of January next following; also for the calendar year for which permit was issued the total number of each species reared and killed, number of each species and their eggs sold and transported, manner in which such waterfowl and eggs were transported, name and address of each person from or to whom waterfowl and eggs were purchased or sold, together with number and species and whether sold alive or dead; and the date of each transaction. A written report correctly setting forth this information shall be furnished the Secretary during the month of January next following the issuance of the permit.

6. A permittee shall at all reasonable hours allow any authorized employee of the United States Department of Agriculture to enter and inspect the premises where operations are being carried on under this regulation and to inspect the books and records of such permittee relating thereto.

7. Permits issued under this regulation shall be valid only during the calendar year of issue, shall not be transferable, and may be revoked by the Secretary, if the permittee violates any of the provisions of the Migratory Bird Treaty Act or of the regulations thereunder.

8. A person engaged in the propagation of migratory waterfowl on the date on which these regulations become effective will be allowed until September 30, 1918, to apply for the permit required by this regulation, but he shall not take any migratory waterfowl without a permit.

REGULATION 9.—PERMITS TO COLLECT MIGRATORY BIRDS FOR SCIENTIFIC PURPOSES.

A person may take in any manner and at any time migratory birds and their nests and eggs for scientific purposes when authorized by a permit issued by the Secretary, which permit shall be carried on his person when he is collecting specimens thereunder and shall be exhibited to any person requesting to see the same.

Application for a permit must be addressed to the Secretary of Agriculture, Washington, D. C., and must contain the following information: Name and address of applicant and name of State, Territory, or District in which specimens are proposed to be taken and the purpose for which they are intended. Each application shall be accompanied by certificates from two well-known ornithologists that the applicant is a fit person to be entrusted with a permit.

The permit will authorize the holder thereof to possess, buy, sell, and transport in any manner and at any time migratory birds, parts thereof, and their nests and eggs for scientific purposes. Public museums, zoological parks and societies, and public scientific and educational institutions may possess, buy, sell, and transport in any manner and at any time migratory birds and parts thereof, and their nests and eggs for scientific purposes without a permit, but no specimens shall be taken without a permit.

Permits shall be valid only during the calendar year of issue, shall not be transferable, and shall be revocable in the discretion of the Secretary. A person holding a permit shall report to the Secretary on or before January 10 following its expiration the number of skins, nests, or eggs of each species collected, bought, sold, or transported.

Every package in which migratory birds or their nests or eggs are transported shall have clearly and conspicuously marked on the outside thereof the name and address of the sender, the number of the permit in every case when a permit is required, the name and address of the consignee, a statement that it contains specimens of birds, their nests, or eggs for scientific purposes, and whenever such a package is transported or offered for transportation from the Dominion of Canada into the United States or from the United States into the Dominion of Canada, an accurate statement of the contents.

REGULATION 10.—PERMITS TO KILL MIGRATORY BIRDS INJURIOUS TO PROPERTY.

When information is furnished the Secretary that any species of migratory bird has become, under extraordinary conditions, seriously injurious to agriculture or other interests in any particular community, an investigation will be made to determine the nature and extent of the injury, whether the birds alleged to be doing the damage should be killed, and, if so, during what times and by what means. Upon his determination an appropriate order will be made.

NOW, THEREFORE, I, WOODROW WILSON, PRESIDENT OF THE UNITED STATES OF AMERICA, DO HEREBY APPROVE AND PROCLAIM the foregoing regulations.

IN WITNESS WHEREOF, I have hereunto set my hand and caused the seal of the United States of America to be affixed.

DONE in the District of Columbia, this thirty-first day of July, in the year of our Lord One Thousand Nine Hundred and Eighteen and of the Independence of the United States of America the One Hundred and Forty-third.
[SEAL.]

WOODROW WILSON.

By the President:
FRANK L. POLK,
Acting Secretary of State.

CANADIAN REGULATIONS UNDER MIGRATORY BIRDS CONVENTION ACT.

1. In these regulations, unless the context otherwise requires—

(*a*) "Migratory game birds" means the following:

Anatidæ or waterfowl, including brant, wild ducks, geese, and swans;

Gruidæ or cranes, including little brown[,] sandhill and whooping cranes;

Rallidæ or rails, including coots, gallinules, and sora and other rails;

Limicolæ or shorebirds, including avocets, curlew, dowitchers, godwits, knots, oyster catchers, phalaropes, plovers, sandpipers, snipe, stilts, surf birds, turnstones, willet, woodcock, and yellowlegs;

Columbidæ or pigeons, including doves and wild pigeons.

(*b*) "Migratory insectivorous birds" means the following:

Bobolinks, catbirds, chickadees, cuckoos, flickers, fly-catchers, grosbeaks, humming birds, kinglets, martins, meadowlarks, nighthawks or bull bats, nuthatches, orioles, robins, shrikes, swallows, swifts, tanagers, titmice, thrushes, vireos, warblers, waxwings, whippoorwill, woodpeckers, and wrens, and all other perching birds which feed entirely or chiefly on insects.

(*c*) "Migratory nongame birds" means the following:

Auks, auklets, bitterns, fulmars, gannets, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, and terns.

2. No person shall kill, capture, injure, take, molest, sell, or offer for sale any migratory game birds during the following periods:

In Prince Edward Island, New Brunswick, Quebec, Ontario, Alberta, British Columbia (northern district), Northwest Territories, and Yukon Territory, December 15 to August 31, both days inclusive.

In Manitoba, December 1 to September 14, both days inclusive.

In Nova Scotia, Saskatchewan, and British Columbia (southeastern district), January 1 to September 14, both days inclusive.

In British Columbia (southwestern district), January 15 to September 30, both days inclusive.

Shore birds or waders, including only the following:

Woodcock, Wilson or jack snipe, blackbreasted and golden plover, and the greater and lesser yellowlegs.

In Prince Edward Island, Nova Scotia, New Brunswick, and in the counties of Saguenay, Rimouski, Gaspe, and Bonaventure in Quebec:

December 1 to August 14, both days inclusive, except that on woodcock and Wilson or jack snipe the closed season in Prince Edward Island and New Brunswick shall be from December 1 to September 14, and in Nova Scotia from December 15 to August 31, both days inclusive.

In Quebec, other than the aforementioned maritime counties, Ontario, Alberta, British Columbia (northern district), Northwest Territories, and Yukon Territory, December 15 to August 31, both days inclusive, except that on woodcock and Wilson or jack snipe the close season in Ontario shall be from November 15 to October 14, both days inclusive.

In Manitoba: December 1 to September 14, both days inclusive.

In Saskatchewan and British Columbia (southeastern district): January 1 to September 14, both days inclusive.

In British Columbia (southwestern district): January 15 to September 30, both days inclusive.

Provided, however, That—

Indians and Eskimos may take scoters or "Siwash ducks" for food at any time of the year, but scoters so taken shall not be sold.

In this or any other regulation the southern limit of the northern district of British Columbia shall be, west to east, a line running by way of the middle of Dean Channel, Dean River, Entiako River, Nechako River, and the Fraser River from Fort George to Yellowhead Pass; and the line of division between the southeastern and the southwestern districts of British Columbia shall be the summit of the Cascade Range, as defined by the British Columbia interpretation act, Revised Statutes, 1911.

3. The killing, capturing, taking, injuring, or molesting of migratory insectivorous birds, their eggs, or nests, is prohibited throughout the year, except as hereinafter provided.

4. The killing, taking, injuring, capturing or molesting of migratory nongame birds or their eggs or nests, except as herein or hereinafter provided, is prohibited throughout the year; *Provided, however*, That Indians and Eskimos may take at any season auks, auklets, guillemots, murres, and puffins and their eggs for human food and their skins for clothing, but birds and eggs taken in virtue of this exemption shall not be sold or offered for sale or otherwise traded.

5. A close season shall continue until the 1st day of January, 1928, on the following migratory game birds: Band-tailed pigeons, little brown, sandhill, and whooping cranes, swans, curlew, and all shore birds (except the blackbreasted and golden plover, Wilson or jack snipe, woodcock, and the greater and lesser yellowlegs). In the Province of British Columbia during such period the close season on cranes, swans, and curlew shall be made by the proper authorities of that Province within the general dates and limitations elsewhere prescribed in these regulations for the respective groups to which these birds belong or greater restrictions on the hunting of these birds shall be made should the aforementioned authorities deem such further restrictions desirable, as provided by Article III of the convention between His Majesty and the United States of America, scheduled to chapter 18, 7-8 George V.

6. A close season shall continue until the 1st day of January, 1923, on the wood duck and eider duck, except that in the Province of British Columbia the

wood duck shall be protected by such special means or regulations as the proper authorities of that Province may deem appropriate, as provided by the convention referred to in clause 5.

7. The taking of the nests or eggs of migratory game, migratory insectivorous or migratory nongame birds is prohibited except as otherwise provided in the regulations.

8. Migratory game, migratory insectivorous or migratory nongame birds or parts thereof or their eggs or nests may be taken, shipped, transported or possessed for scientific or propagating purposes, but only on the issue of a permit by the minister or by any person duly authorized by him. Such a permit shall terminate at the end of the calendar year in which it shall have been issued; it shall not be transferable, and shall be revocable at the discretion of the minister.

Such permits may, upon application, be granted to recognized museums or scientific societies, and to any person furnishing written testimonials from two well-known ornithologists.

Applications for permits for propagating purposes shall be accompanied by a statement giving—

(1) The species of birds or eggs that it is desired to take,

(2) The number,

(3) The place at which the birds or eggs are to be taken.

Any package in which such migratory game, migratory insectivorous, or migratory nongame birds or parts thereof or their eggs or nests are shipped or transported for scientific or propagating purposes shall be clearly marked on the outside with the number of the permit, the name and address of the shipper and an accurate statement of the contents.

No transportation company shall accept for transportation any package containing eggs, nests, or parts of migratory game, migratory insectivorous or migratory nongame birds unless such package shall be marked as hereinbefore required, and shipment of the same through the mails is prohibited, unless marked as aforesaid.

9. The shipment or export of migratory game, migratory insectivorous, or migratory nongame birds or their eggs from any Province during the close season in such Provinces is prohibited except for scientific or propagating purposes and traffic between Canada and the United States in any such birds, or their eggs, captured, killed, taken, or shipped at any time contrary to the laws of the Province or State in which the same are captured, killed, taken or shipped, is likewise prohibited.

10. No person shall ship or offer for shipment from Canada to the United States any package containing migratory game, migratory insectivorous or migratory nongame birds or any parts thereof or their eggs unless such package shall have the name and address of the shipper and an accurate statement of the contents clearly marked on the outside of such package.

No transportation company shall accept for transportation to the United States, any packages of migratory game, migratory insectivorous or migratory nongame birds or any parts thereof or their eggs unless such packages bear the name and address of the shipper and an accurate statement of the contents, and shipment of the same through the mails is prohibited, unless marked as aforesaid.

11. If any of the migratory game, migratory insectivorous, or migratory nongame birds should, under extraordinary conditions, become seriously injurious to agricultural, fishing, or other interests in any particular locality the minister

may issue permits to kill such birds so long as they shall continue to be injurious. Applications for such permits shall include a full statement describing:

(1) The species and an estimate of the number of birds committing the damage.

(2) The nature and extent of the damage.

(3) The extent of the agricultural or other interests threatened or involved. Such permits shall be revocable at the discretion of the minister. On the expiration of the permit the person to whom it is issued shall furnish to the minister a written report showing the number of birds killed, the dates upon which they were killed and the disposition made of the dead birds.

No birds killed under such permits shall be shipped, sold, or offered for sale.

12. No person or organization shall introduce for the purpose of sport or acclimatization any species of migratory birds without the consent of the minister in writing.

MEMORANDUM ON THE USE OF GAME AS FOOD.

BY THE UNITED STATES FOOD ADMINISTRATION.

(Issued Mar. 4, 1918.)

The problem of providing for the country a maximum supply of game as food has been carefully considered by the Food Administration. It has reached the conclusion that this maximum supply can best be obtained by constantly increasing the breeding reserve of game under present and even more progressive laws directed toward that end.

Up to a short time ago no fact was more clear than that the game of the country has been decreasing, some species even approaching the point of extinction. That the energies of the whole country have been directed toward increasing the stock of game is demonstrated by the fact that many State legislatures have decreased the amount of the game to be killed by individuals, and shortened the seasons in which game could be killed. Notwithstanding these efforts, the decrease in game became so serious that a universal demand throughout the country persuaded Congress to pass a law placing the jurisdiction of migratory game birds under Federal supervision. Canada passed through the same experience, as is proved by a treaty negotiated with the United States practically incorporating the terms of the migratory-bird law passed by Congress. The result of better State laws and the migratory-bird law has been a positive increase of waterfowl and a wide extension southward of the breeding of waterfowl. It is perfectly clear that this increased breeding reserve gives more individual citizens opportunities to kill game for food, which opportunities must necessarily increase each year proportionately to the increase of the breeding reserve.

Any effort to weaken the present laws or in any way to relax them in one locality would immediately lead to a demand for such relaxation of laws in all other localities insuring a rapid break-down of the whole legal structure of present game protection erected after efforts extending over many years. Once the perfected laws were relaxed to the point where game could be killed more freely, notwithstanding the fact that numerous gunners have gone to war, the game would be quickly destroyed by largely increased numbers of local gunners using modern methods of transportation such as automobiles, motor boats, and trolley roads and improved firearms. The present game supply of the country should be considered in exactly the same way as that of domestic stock and fowls, the breeding reserve of which should be increased to insure increased supplies for food. This is even more necessary for much of the wild game, since once it is destroyed to a certain point it will decrease under natural conditions to extinction, and can never, as is the case of domestic stock, be restored.

To advocate the relaxation of State game laws would not secure uniformity in action or results since State legislatures can not be brought to exactly the same views, and most of the States will not have regular sessions for another year. Since an attempted relaxation of laws would tend toward a rapid destruction of game, no emergency has as yet arisen sufficiently acute to warrant the Food Administration advocating the destruction or impairment of game which forms a valuable national asset.

It may be added that no extensions of the hunting season or bag limits beyond those now specified in the State game laws could be legally made without action by the State legislatures, most of which will not meet until a year from the coming winter. Furthermore, any action taken in this country which would contravene the migratory-bird treaty between the United States and Great Britain would be deeply resented by Canada, which has fulfilled its obligations under this treaty by enacting suitable laws and regulations to carry out its provisions.

OFFICIALS FROM WHOM COPIES OF GAME LAWS MAY BE OBTAINED.

Alabama: State game and fish commissioner, Montgomery.

Alaska: The governor, Juneau; Secretary of Agriculture, Washington, D. C.

Arizona: State game warden, Phoenix.

Arkansas: Secretary, game and fish commission, Little Rock.

California: Executive officer, fish and game commission, New Call Building, San Francisco.

Colorado: State game and fish commissioner, Denver.

Connecticut: Secretary, commission of fisheries and game, Hartford.

Delaware: Chief game warden, Dover.

District of Columbia: Superintendent Metropolitan Police, Washington.

Florida: Secretary of state, Tallahassee.

Georgia: Game and fish commissioner, Atlanta.

Idaho: Fish and game warden, Boise.

Illinois: Chief game and fish warden, Springfield.

Indiana: Commissioner fisheries and game, Indianapolis.

Iowa: State fish and game warden, Spirit Lake.

Kansas: State fish and game warden, Pratt.

Kentucky: Executive agent, game and fish commission, Frankfort.

Louisiana: Commissioner of conservation, Court Building, New Orleans.

Maine: Commissioner of inland fisheries and game, Augusta.

Maryland: State game warden, 512 Munsey Building, Baltimore.

Massachusetts: Chairman, commissioners of fisheries and game, State House, Boston.

Michigan: Commissioner game, fish, and forest-fire department, Lansing.

Minnesota: Game and fish commissioner. St. Paul.

Mississippi: Secretary of state, Jackson.

Missouri: Game and fish commissioner, Jefferson City.

Montana: State game warden, Helena.

Nebraska: Chief deputy, game and fish commission, Lincoln.

Nevada: State fish and game warden, Carson City.

New Hampshire: Fish and game commissioner, Milford.

New Jersey: Secretary, board of fish and game commissioners, Trenton.

New Mexico: Game and fish warden, Santa Fe.

New York: Secretary of conservation commission, Albany.

North Carolina: Secretary, Audubon Society of North Carolina, Raleigh.

North Dakota: Secretary, game and fish board, Steele.

Ohio: Chief game warden, board of agriculture, Columbus.

Oklahoma: State game warden, Oklahoma City.

Oregon: State game warden, Portland.

Pennsylvania: Secretary, board of game commissioners, Harrisburg.

Rhode Island: Chairman, commissioners of birds, Rumford.

South Carolina: Chief game warden, Columbia.

South Dakota: State game warden, Pierre.

Tennessee: State game and fish warden, Nashville.

Texas: Game, fish, and oyster commissioner, Austin.

Utah: Fish and game commissioner, Salt Lake City.

Vermont: Fish and game commissioner, Cambridge.

Virginia: Commissioner of game and inland fisheries, Richmond.

Washington: Chief game warden and State fish commissioner, Seattle; chief deputy game warden, Spokane.

West Virginia: Forest, game, and fish warden, Philippi.

Wisconsin: Secretary, conservation commission, Madison.

Wyoming: State game warden, Lander.

CANADA.

Alberta: Chief game guardian, Edmonton.

British Columbia: Game Conservation Board, Victoria.

Manitoba: Chief game guardian, Winnipeg.

New Brunswick: Chief game and fire warden, Richibucto.

Northwest Territories: Commissioner of Parks, Ottawa.

Nova Scotia: Chief game commissioner, Halifax.

Ontario: Superintendent game and fisheries, Toronto.

Prince Edward Island: Game inspector, Charlottetown.

Quebec: General inspector of fisheries and game, Quebec.

Saskatchewan: Chief game guardian, Regina.

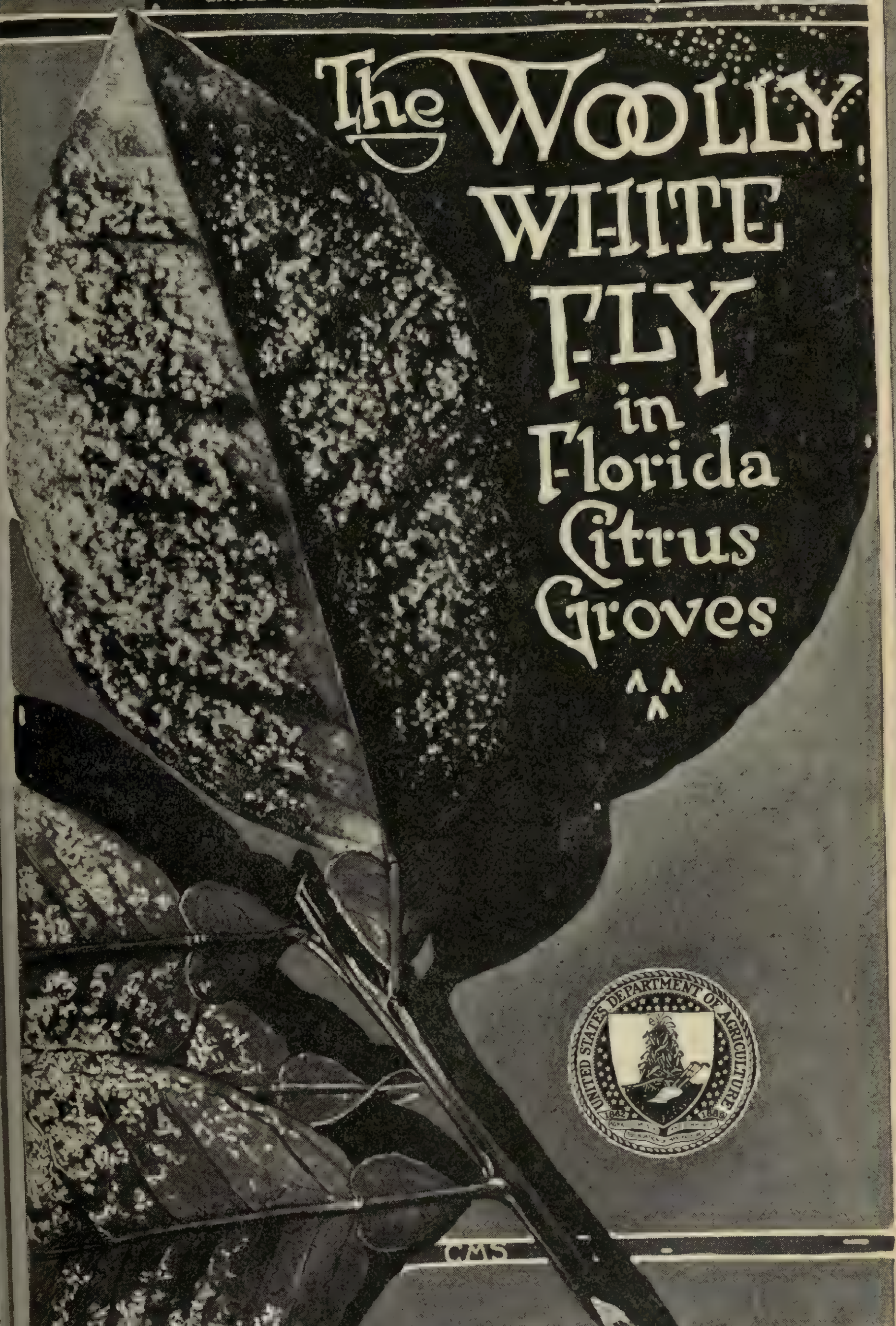
Yukon: Territorial secretary, Dawson.

Colony of Newfoundland: Secretary, department of marine and fisheries, St. Johns.

FARMERS' BULLETIN 1011

UNITED STATES DEPARTMENT OF AGRICULTURE

The WOOLLY WHITE FLY in Florida Citrus Groves



THE RAPID SPREAD of the woolly white fly over a greater portion of the citrus-producing sections of Florida has caused some alarm among the owners of orange groves. This bulletin contains information regarding the introduction of the woolly white fly into the United States and its subsequent spread. It shows the grower how to distinguish this pest from all other white flies attacking citrus in Florida, gives a general outline of its life history, tells something about its natural enemies, which usually control it, and describes the remedial measures to be applied in case the natural enemies do not seem to promise aid in the near future.

Contribution from the Bureau of Entomology
L. O. HOWARD, Chief
Washington, D. C. February, 1919

THE WOOLLY WHITE FLY IN FLORIDA CITRUS GROVES.[1]

W. W. YOTHERS,
Entomological Assistant, Tropical and Subtropical Fruit Insect Investigations.

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WHAT THE WOOLLY WHITE FLY IS LIKE.

THE WOOLLY WHITE FLY (fig. 1), the most recently introduced of the insect pests of Florida citrus groves, and still comparatively little known, is capable at times of rivaling in destructiveness both the citrus white fly[2] and the cloudy-winged white fly,[3] which have been present in Florida much longer and are causing a great annual loss to Florida and Gulf coast growers.

The woolly white fly is a tiny four-winged insect about one-sixteenth of an inch long, covered with a delicate, snowy-white, waxy secretion which hides the yellow color of the body. As with other insects of the white-fly family, the young, or larvæ, which hatch from the minute, almost dustlike eggs, pass through several stages before becoming winged adults. In all of these stages the insect possesses legs, but can use them only in the first stage. The last immature stage is known as the pupa, or resting stage. Larvæ and pupæ of the woolly white fly are clothed with a dense, wool-like covering (figs. 2 and 3) which has suggested the name by which this species is popularly known. Larvæ, pupæ, and adult flies feed by sucking up sap from the leaves of their host plants.

INTRODUCTION AND SPREAD IN FLORIDA.

Whereas the common citrus and cloudy-winged white flies undoubtedly were introduced from southern Asia, the woolly white fly appears to be a native of the West Indies region and doubtless was brought into Florida from Cuba. This insect was first observed in 1903 in Cuba, and later, in 1905, was found in considerable abundance at Artamisa, Cuba. It is now known to be fairly widespread in Cuba, the Isle of Pines, Porto Rico, Mexico, and parts of Florida.

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[1] *Aleurothrixus howardi* (Quaintance); order Hemiptera, suborder Homoptera, family Aleyrodidae.

[2] *Dialeurodes citri* (Ashmead).

[3] *Dialeurodes citrifolii* (Morgan).

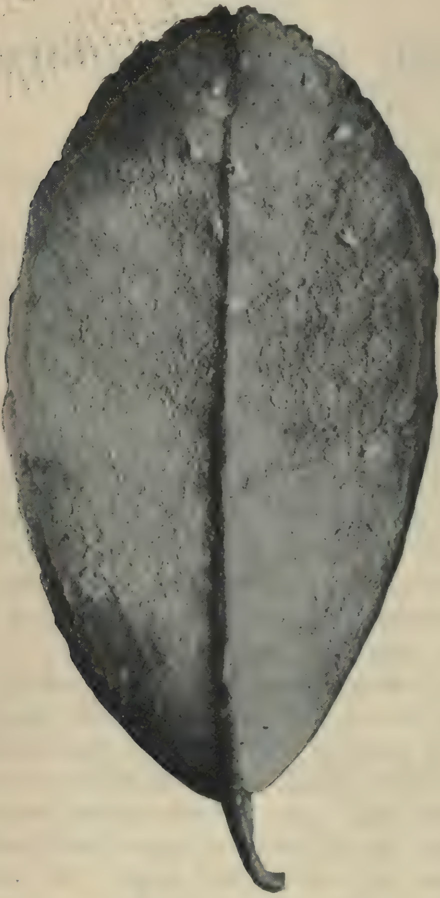

FIG. 1.—Several adults of the woolly white fly on the underside of an orange leaf. The white wings are held farther apart than are those of either the citrus (fig. 5) or cloudy-winged (fig. 6) white flies.

It was first found in Florida at Miami, in 1900, on sea grape but apparently obtained no general foothold in Florida from this colony. Its appearance as an economic pest in Florida dates from November, 1909, when it was observed heavily infesting orange trees at Tampa. When it was discovered at Tampa it was present in greatest numbers on trees near the Hillsboro River at points where the boats from Cuba and other places docked, and near the depot, indicating its probable introduction by means of cargoes or travelers direct from Cuba. From Tampa it has since spread rapidly throughout Florida and is now well distributed over Hillsboro, Pinellas, Manatee, Polk, De Soto, Orange, Lee, and portions of Palm Beach counties, and doubtless soon will infest all the citrus groves in the State.

HOST PLANTS.

The woolly white fly thrives best on citrus trees and prefers them to others, although it has been found attacking the sea grape, common guava, mango, and a species of rubber tree. It is not numerous enough on any of its hosts, except citrus, to be noticeably injurious. Thus, on Sanibel Island, in 1909, only three specimens were found on one leaf of sea grape during a search of half an hour.

Of citrus trees, grapefruit is the favorite with this insect, the orange comes next in attractiveness, and tangerine, lemon, and kumquat trees are not so generally attacked. The woolly white fly has never been found on any forest tree or shrub.

HOW TO DISTINGUISH THE WOOLLY WHITE FLY FROM THE CITRUS AND CLOUDY-WINGED WHITE FLIES.

The woolly white fly is distinguished at once from all other white flies attacking citrus trees in Florida at the present time by the dense white, wool-like covering that develops from the back and sides of the immature stages. This woolly covering, which may be from one-eighth to one-fourth of an inch thick, develops upon the larvæ and pupæ of the white fly and has a protective effect. It causes the underside of badly infested leaves to appear covered with white down. Neither the citrus white fly (see fig. 7) nor the cloudy-winged white fly produces wool-like secretions; in fact, these two species are so transparent that the immature stages are very inconspicuous. There are also differences, although less pronounced, between the adults and eggs of all of these white flies. Neither of the other citrus white flies lays its eggs in circles (fig. 4) as does the female of the woolly white fly. Then, too, the adult of the woolly white fly does not fold its wings so closely over its back. (Compare fig. 1 with figs. 5 and 6.)

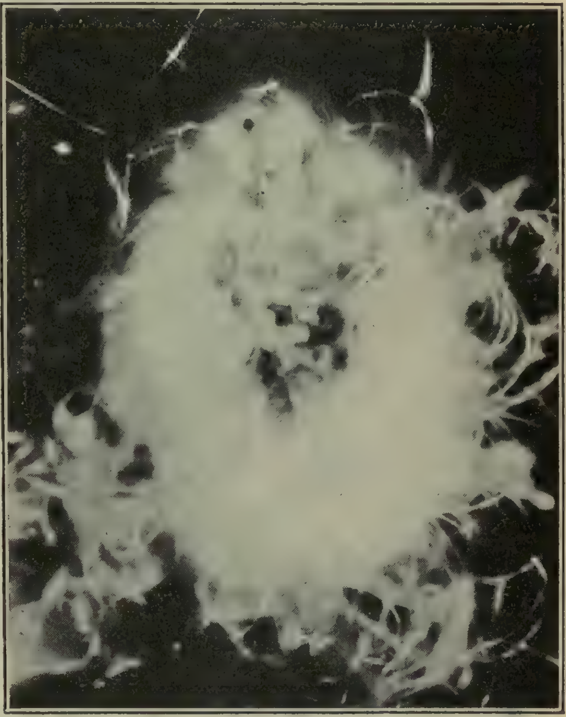
FIG. 2.—A pupa case of the woolly white fly, greatly enlarged, to show the white, wool-like secretions covering the insect itself. This heavy covering makes effective spraying difficult. (Watson.)

SECRETION OF HONEYDEW AND GROWTH OF SOOTY MOLD.

Although the larvæ and pupæ of the woolly white fly secrete large quantities of honeydew, sooty mold does not grow so freely on this honeydew as on that secreted by the citrus and cloudy-

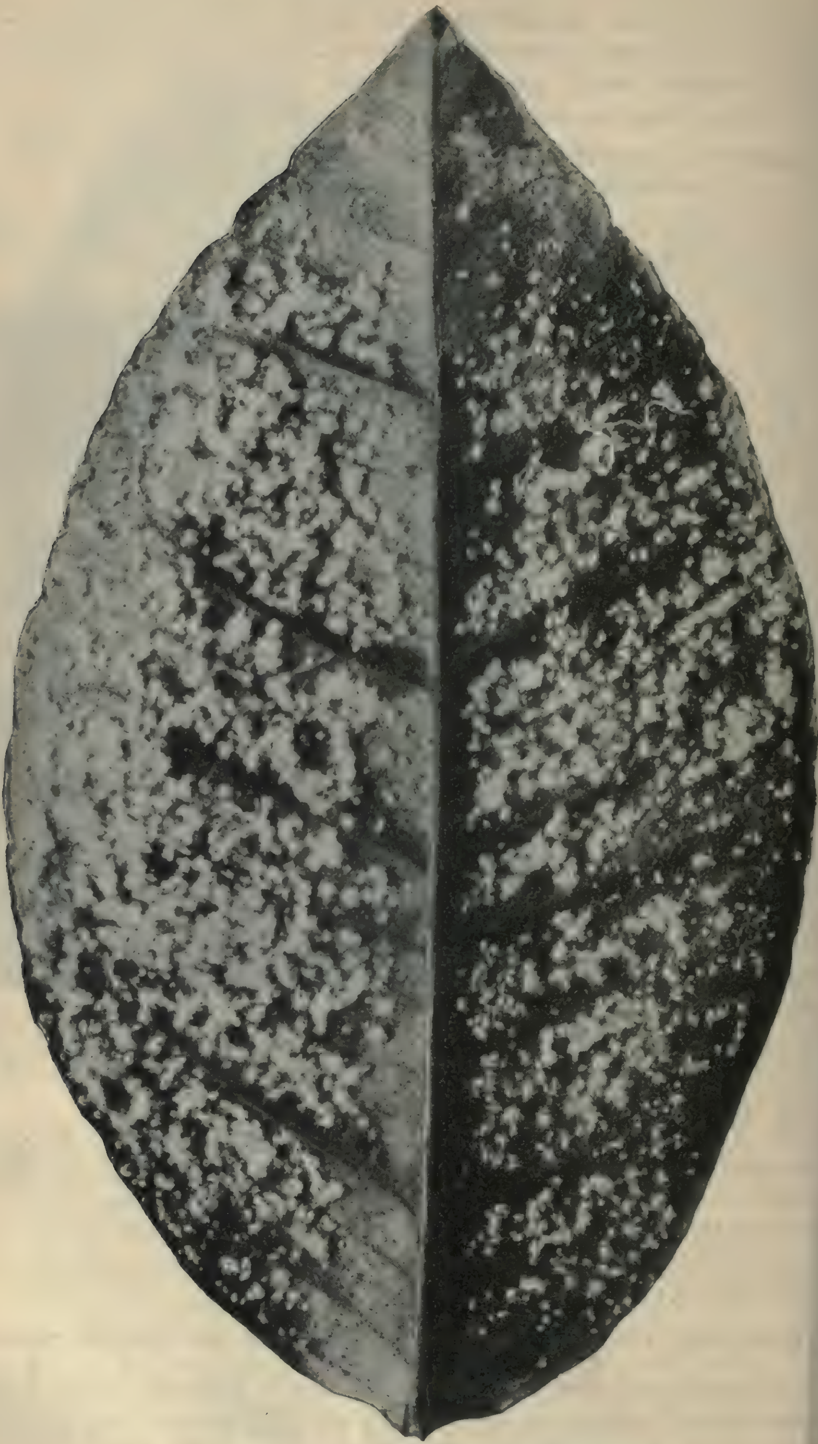

FIG. 3.—Orange leaf infested with the woolly white fly.

winged white flies. It is not thrown out to fall upon the upper surfaces of the leaves below unless the flies, larvæ, and pupæ are very abundant, but collects in large globules or drops, as illustrated in figure 8, in the woolly covering of the insect. These drops often become one-eighth of an inch in diameter and may be so numerous as to cause the leaves and even the smaller branches to droop slightly under their weight. When a branch infested by this white fly is jarred sharply, the drops of honeydew fall in a shower, and in badly infested groves the accumulation of honeydew makes the leaves and branches very sticky. This stickiness causes much annoyance to orange pickers and to men and mules engaged in cultural work. It has about the same effect upon the hair and clothing as molasses. In older colonies these drops of honeydew become overgrown with a fungus that makes them appear olive-green or black.

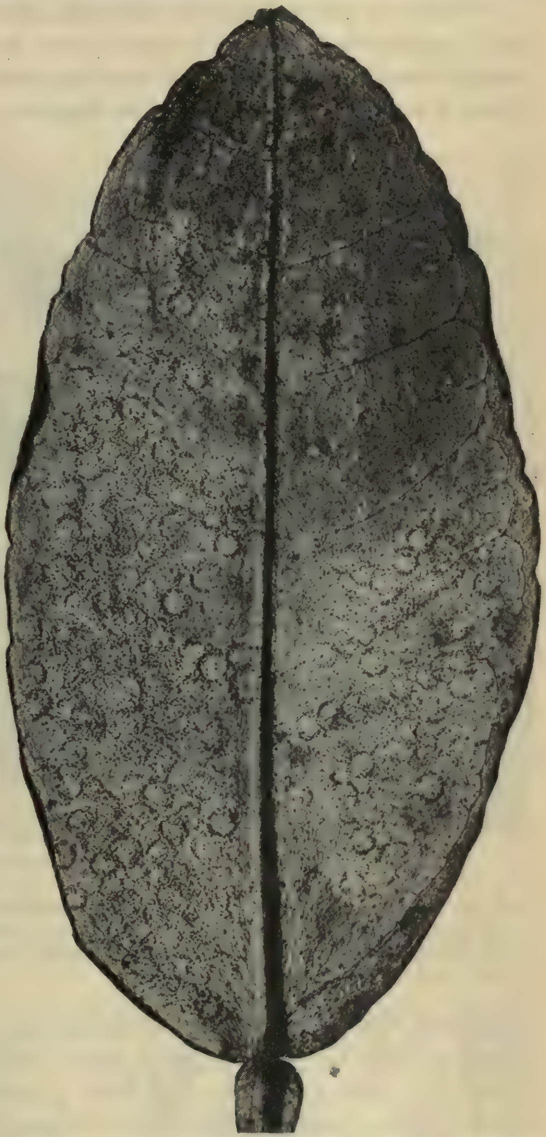

FIG. 4.—Grapefruit leaf showing eggs of the woolly white fly appearing as particles of dust on the underside. Many of them are laid in circles. No other white flies attacking citrus trees in Florida lay their eggs in circles. About natural size. (Back.)

SEASONAL ACTIVITY.

The seasonal activity of the woolly white fly, like that of the other white flies in Florida, has a bearing upon control measures. This pest has four generations a year. Adults are present in the greatest numbers on the trees during four periods: (1) December and January, (2) the latter part of May,

(3) the latter part of July, and (4) October and November. The fall brood coincides very closely with that of the cloudy-winged white fly. During the summer a generation may mature in from 10 to 11 weeks.

When infestation becomes so severe that the trees must be sprayed, the grower should watch closely for the emergence of adults and spray about one week after the flies have disappeared, for by this time the eggs deposited by the females will have largely hatched, and the young larvæ will not yet have developed the thick woolly covering which later will protect them in a large measure from even the most thorough application of spray.

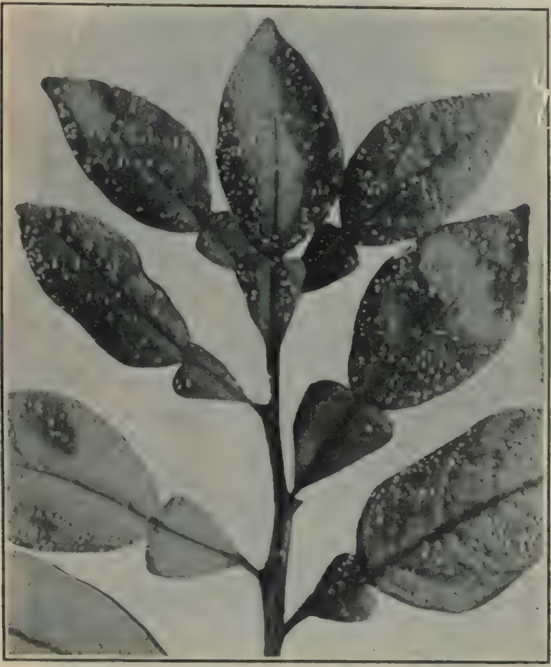

FIG. 5.—Adults of the citrus white fly. These insects have white wings and bodies, are about one-sixteenth of an inch long, and are found upon the underside of leaves of citrus trees, chiefly upon the new growth. They resemble very much the adults of the woolly white fly.

THE WOOLLY WHITE FLY FAVORS SCALE INCREASE.

The presence of the woolly white fly favors the increase of the purple scale.[1] This scale prefers shaded spots. It has been found [2] that the "crawlers," or first-stage larvæ or young of the scale, avoid the light and seek the protection of any substance on the leaf or branches that affords them suitable environment. The woolly covering affords the scale a good place to hide and develop, protected from its natural enemies and from adverse weather conditions such as drenching rains. After the colonies of the woolly white fly have died out numerous purple scales will be found beneath the woolly coverings. Indeed, so characteristic is this gathering of scales beneath the woolly secretions that the white fly can be located on trees by the yellow spots on the leaves caused by the injury of the scales. This, of course, is true only of the older leaves. Trees once infested by the woolly white fly must be watched carefully for some time after the white fly itself has ceased to cause injury, as the purple scale continues to breed in the débris of the old white-fly colonies and there multiplies unhindered, and in the favorable semidarkness of the woolly covering may increase unnoticed to a point where it causes far greater injury than did the white fly.

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[1] *Lepidosaphes beckii* Newman.

[2] Watson, J. R., Insects of a Citrus Grove. Univ. of Fla. Agr. Exp. Sta. Bul. 148, p. 165–267, 142 fig., June, 1918. (See p. 189.)

NATURAL ENEMIES.

Fortunately for the Florida grower, the woolly white fly has a number of natural enemies. The most efficient of these is a tiny wasplike parasite about one-twenty-fifth of an inch long, which lays its egg in the body of the larva or pupa of the white fly. The egg hatches into a larva which, as it grows, feeds upon the white fly and kills it, causing it to turn black. When the parasite becomes adult it eats a small round hole in the back of the white-fly pupa, crawls out, and begins to search for other white flies in which to lay its eggs. Parasitized pupæ of this white fly were first observed on Sanibel Island, on sea grape, in 1909, and the parasites were first reared in 1913. Since then this parasite has appeared in all groves in which the woolly white fly is present. Often every white fly upon a leaf will be found with the small round hole in its back, indicating that it was killed by the parasite. It is seldom that this parasite does not effectively check any infestation, no matter how severe it may be, within the course of 3 to 4 months. In fact, so thoroughly does it control the woolly white fly under Florida conditions that it is doubtful whether growers need concern themselves unduly when they discover this pest in their groves.

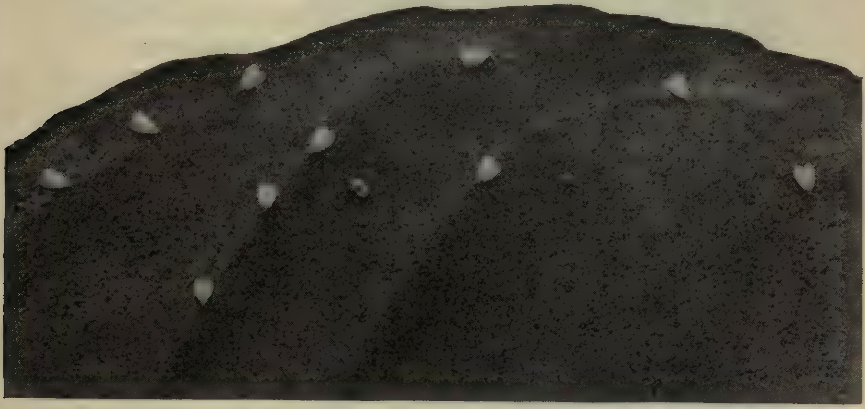

FIG. 6.—Adults of the cloudy-winged white fly, slightly enlarged. The insects are about one-sixteenth of an inch long and have a dark, clouded spot at the tip of the wings. (Morrill and Back.)

It is always wise when the woolly white fly appears in a grove for the first time, or appears to be increasing rapidly, to mail a few of the infested leaves in a sealed metal container to the State Experiment Station, Gainesville, Fla., or to the Bureau of Entomology, Washington, D. C., so that the presence or absence of the parasite may be determined, and, if absent, arrangements may be made to colonize it artificially.

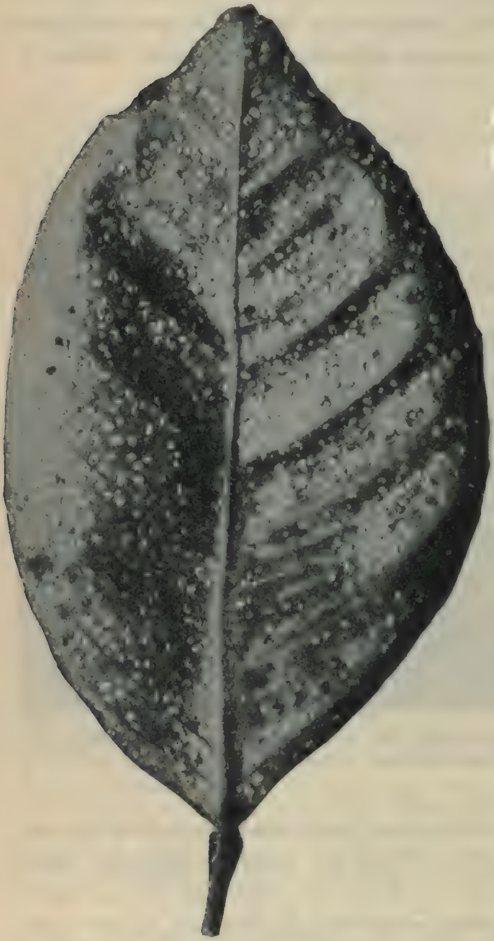

FIG. 7.—Leaf of orange the underside of which is heavily infested with the larvæ, pupæ, and pupa cases of the citrus white fly. The immature stages are difficult to see. There are about 800 on this leaf. This species lacks the dense, woolly covering that characterizes the woolly white fly. (Morrill and Back.)

Both the red fungus and the brown fungus which are parasitic on the citrus white fly have been found attacking the woolly white fly, but the good they do is very slight in most instances.

A large number of the woolly white flies die for some reason not yet determined, and a tortricid moth has been seen killing out colonies of the pest in both Cuba and Florida.

ARTIFICIAL METHODS OF CONTROL.

If in any locality parasites do not seem to promise aid in the near future and the pest is spreading rapidly, it may be advisable to spray to check the increase until the parasites become effective. It is best to spray when the white fly is young and before the larvæ have developed their protective woolly covering. The proper spraying period is about a week or ten days after a majority of the adults of any generation have ceased to fly.

Any of the sprays of value in the control of either of the other citrus white flies, or of the scale insects infesting citrus, are effective in checking the woolly white fly. The oil emulsions recommended by this department, however, have been found most satisfactory. These have a base of cheap lubricating oil, or what may also be called paraffin oil, and may be made into emulsions according to the following formula:

Cold-stirred emulsion.

Fish-oil soap	pounds	6 to 8
Paraffin oil	gallons	2
Water	gallon	1

Directions for preparation.—In preparing the stock mixture, the soap should be put into a receptacle of about 5 gallons capacity. The oil should then be added slowly while the mixture is being stirred. It is important that the oil be added in small quantities at first and also that the stirring be sufficient to keep the oil and soap in the form of an emulsion after each addition of oil. Thus at first about a pint should be added to the soap and the mixture stirred until no free oil appears. As the amount of oil is increased, it should always be stirred or mixed thoroughly before the next addition is made. After the required amount of oil has been added, and all free oil has disappeared from the top of the mixture, water is poured in slowly, about a quart at a time. The only implements required to make this formula in small quantities are an ordinary pail and a paddle. By adding 1 gallon of this stock solution to 50 gallons of water a spray solution is formed containing about 1 per cent of oil. This is sufficiently strong to kill white flies.

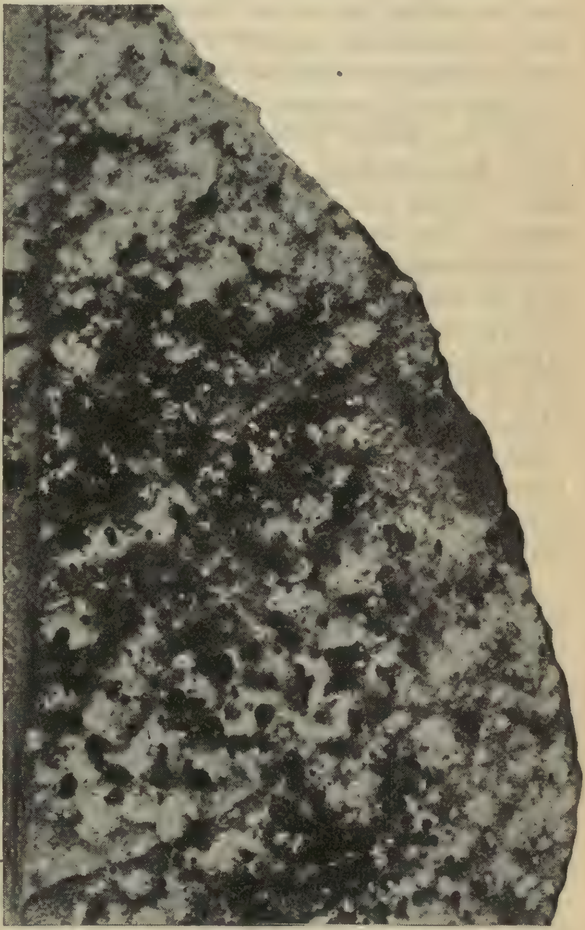

FIG. 8.—Section of grapefruit leaf showing the drops of honeydew caught in the woolly secretions. Many of these larvæ become black owing to the growth of a fungus known as sooty mold. (Back.)

Many alterations may be made in the foregoing formula. The quantity of soap required will depend largely upon the time consumed in adding the oil and the amount of stirring accompanying this process. The amount of soap is lessened if the stirring is uniform and if ample time is taken in the preparation.

If it is desired that this spray solution be made on a large scale, that the boiled formula, which costs somewhat less, be used, or that hard instead of lake water be employed, application should be made to the U. S. Department of Agriculture for Farmers' Bulletin 933, which discusses more fully spray mixtures for white flies and scale insects.

SUMMARY.

(1) The woolly white fly, while not usually so injurious to citrus trees as either the citrus white fly or the cloudy-winged white fly, may be exceedingly injurious at times. Like them it is an introduced pest. Indications are that it was introduced into Florida from Cuba, and that it first secured a permanent foothold at Tampa.

(2) The woolly white fly is at once distinguished from all other white flies attacking citrus trees in Florida by the dense, white, wool-like covering that develops from the back and sides of the immature stages. The immature stages of both the citrus white fly and the cloudy-winged white fly, on the other hand, are almost transparent and do not produce wool-like secretions. Many of the eggs of the woolly white fly are laid in circles, which is not the case with any other known white fly on citrus.

(3) This pest favors the increase of the purple scale. The young of this scale find a most favorable location for development in the wool-like secretions that follow infestation by this fly. Trees that have had a heavy infestation of the woolly white fly should be watched carefully for the purple scale, so that the proper remedial measures may be taken if much damage from the latter threatens.

(4) The woolly white fly is usually controlled by an internal parasite. If the pupæ show small round holes on the back, it is proof that these beneficial insects are present. In case the parasites do not seem to promise aid in the near future and the pest is spreading rapidly, it may be advisable to spray with one of the oil emulsions to assist in preventing any serious damage to the trees. The spray should be applied about a week or ten days after the disappearance of the adults, when a majority of the eggs have hatched and before the immature stages have developed very much of their protective woolly covering. It is very difficult to obtain satisfactory results if the spraying is directed against the pupæ, since the wool-like covering prevents the spray from coming in contact with the body of the insect.

(5) When a grower finds this pest present in his grove, a sample of leaves should be sent in a sealed metal container to either the State Experiment Station, Gainesville, Fla., or the Bureau of Entomology, United States Department of Agriculture, Washington, D. C. An examination of the leaves will determine whether or not the parasite referred to in paragraph 4 is present and what remedial measures, if any, should be taken.

PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE RELATING TO FRUIT INSECTS.

PUBLICATIONS AVAILABLE FOR FREE DISTRIBUTION.

Control of the Citrus Thrips in California and Arizona. (Farmers' Bulletin 674.)
Handling and Shipping Citrus Fruits in the Gulf States. (Farmers' Bulletin 696.)
Citrus Fruit Improvement. (Farmers' Bulletin 794.)
Aphids, Injurious to Orchard Fruits, Currants, Goosberries, and Grapes. (Farmers' Bulletin 804.)
Cranberry Insect Problems and Suggestions for Solving Them. (Farmers' Bulletin 860.)
Information for Fruit Growers About Insecticides, Spraying Apparatus, and Important Insect Pests. (Farmers' Bulletin 908.)
Fumigation of Citrus Trees. (Farmers' Bulletin 923.)
Control of the Argentine Ant in Orange Groves. (Farmers' Bulletin 928.)
Spraying for the Control of Insects and Mites Attacking Citrus Trees in Florida. (Farmers' Bulletin 933.)
The Woolly White Fly in Florida Citrus Groves. (Farmers' Bulletin 1011.)
Citrus Fruit Insects in Mediterranean Countries. (Department Bulletin 134.)
Mulched-basin System of Irrigated Citrus Culture and Its Bearing on Control of Mottle-leaf. (Department Bulletin 499.)
The Mediterranean Fruit Fly in Hawaii. (Department Bulletin 536.)
The Striped Peach Worm. (Department Bulletin 599.)
The Mediterranean Fruit Fly. (Department Bulletin 640.)
Some Reasons for Spraying to Control Insect and Mite Enemies of Citrus Trees in Florida. (Department Bulletin 645.)
The Argentine Ant in Relation to Citrus Groves. (Department Bulletin 647.)
Citrus Fruit Improvement; A Study of Bud Variation in the Marsh Grapefruit. (Department Bulletin 697.)
Orange Thrips, Report of Progress, 1909–1910. (Bureau of Entomology Bulletin 99, Part 1.)
Red-banded Thrips. (Entomology Bulletin 99, Part 2.)
Spraying Experiments Against Grape Leafhopper in Lake Erie Valley in 1911. (Entomology Bulletin 116, Part 1.)
Lime-Sulphur as Stomach Poison for Insects. (Bureau of Entomology Bulletin 116, Part 4.)
Wooly Aphis of Apple. (Bureau of Entomology Circular 20.)
Fruit Tree Bark-Beetle. (Bureau of Entomology Circular 29.)
Apple Maggot or Railroad Worm. (Bureau of Entomology Circular 101.)
How to Control Pear Thrips. (Bureau of Entomology Circular 131.)
Cooperative Work in Eradicating Citrus Canker. (Separate 711, from Yearbook, 1917.)
Danger of Introducting Fruit Flies in the United States. (Separate 731, from Yearbook, 1917.)
Wooly Apple Aphis. (Agricultural Report 101.)

PUBLICATIONS FOR SALE BY THE SUPERINTENDENT OF DOCUMENTS, GOVERNMENT PRINTING OFFICE, WASHINGTON, D. C.

Scale Insects and Mites on Citrus Trees. (Farmers' Bulletin 172.) Price, 5 cents.

More Important Insect and Fungous Enemies of Fruit and Foliage of Apple. (Farmers' Bulletin 492.) Price, 5 cents.

Sites, Soils, and Varieties for Citrus Groves in the Gulf States. (Farmers' Bulletin 538.) Price, 5 cents.

Propagation of Citrus Trees in Gulf States. (Farmers' Bulletin 539.) Price, 5 cents.

Culture, Fertilization, and Frost Protection of Citrus Groves in the Gulf States. (Farmers' Bulletin 542.) Price, 5 cents.

Dock False Worm; An Apple Pest. (Department Bulletin 265.) Price, 10 cents.

The Terrapin Scale; An Important Insect Enemy of Peach Orchards. (Department Bulletin 351.) Price, 15 cents.

The Cherry Leaf-Beetle; A Periodically Important Enemy to Cherries. (Department Bulletin 352.) Price, 10 cents.

Apple Leaf-sewer. (Department Bulletin 435.) Price, 5 cents.

The Pear Leaf-worm. (Department Bulletin 438.) Price, 5 cents.

Knot of Citrus Trees Caused by Sphaeropsis Tumefaciens. (Bureau of Plant Industry Bulletin 247.) Price, 15 cents.

Papers on Deciduous Fruit Insects and Insecticides. (Bureau of Entomology Bulletin 68.) Price, 25 cents.

Fumigation for Citrus White Fly as Adapted to Florida Conditions. (Bureau of Entomology Bulletin 76.) Price, 15 cents.

Fumigation Investigations in California. (Bureau of Entomology Bulletin 79.) Price, 15 cents.

Test of Sprays Against European Fruit Lecanium and European Pear Scale. (Bureau of Entomology Bulletin 80, Part 8.) Price, 10 cents.

Paper on Deciduous Fruit Insects and Insecticides. (Bureau of Entomology Bulletin 97.) Price, 25 cents.

Natural Control of White Flies in Florida. (Bureau of Entomology Bulletin 102.) Price, 20 cents.

Plum Curculio. (Entomology Bulletin 103.) Price, 50 cents.

Report of Trips to India and The Orient in Search of Natural Enemies of Citrus White Fly. (Bureau of Entomology Bulletin 120.) Price, 15 cents.

Insects Injurious to Citrus Fruits and Methods for Combating Them. (Porto Rico Bulletin 10.) Price, 10 cents.

Citrus Fruits in Hawaii. (Hawaiian Bulletin 9.) Price, 5 cents.

Information About Spraying for Orchard Insects. (Separate 480 from Yearbook, 1908.) Price, 5 cents.

UNITED STATES DEPARTMENT OF AGRICULTURE
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AGRICULTURE IS THE
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The Preparation of BEES for OUTDOOR WINTERING

Farmers' Bulletin 1012
United States Department of Agriculture

ONE OF THE MOST VITAL parts of the beekeeper's work is the preparation of bees for outdoor wintering. No other phase of beekeeping has so direct an influence on the honey crop of the following season.

The apiary should be located in a protected place and the colonies should not be moved at the time of packing. Directions are given in this bulletin for the proper arrangement of the apiary to prevent confusion due to the shifting of hives.

The amount and character of the packing materials and the most economical type of packing cases are discussed.

A schedule of dates for packing and unpacking the hives is presented for all parts of the United States, and the amount and character of winter stores are indicated.

It is important that none of the factors of good wintering be omitted, and several tests are given so that the beekeeper may determine whether his bees are wintering properly.

Contribution from the Bureau of Entomology
L. O. HOWARD, Chief
Washington, D. C. September, 1918

THE PREPARATION OF BEES FOR OUTDOOR WINTERING.

E. F. PHILLIPS, *Apiculturist, and* GEORGE S. DEMUTH, *Apicultural Assistant.*

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NO PROBLEM confronting the beekeeper in most parts of the United States is of more importance than the proper wintering of bees, yet it is one which is sadly neglected. It is urged that before attempting to make packing cases for the wintering of bees the beekeeper study Department Bulletin 93, Temperature of the Honeybee Cluster in Winter, and Farmers' Bulletin 695, Outdoor Wintering of Bees.

THE ESSENTIALS TO SUCCESS.

The essentials to success in caring for a normal colony of bees from the end of one season's honey-flow to the beginning of the next lie in providing three things in abundance: (1) Stores of good quality, (2) protection from wind and cold, and (3) room for the rearing of brood at appropriate times. These factors are all of the greatest importance, and an omission of any one of them may prevent completely the gathering of the honey crop of the following year, and if any of the factors are given in less degree the honey crop invariably is reduced. The importance of these essentials does not apply equally at all times from the end of one season to the beginning of the next, but at some time they are all vitally essential; and it is the purpose of this bulletin to show how all three may be given in the early fall, so that, without further handling, the colonies will come through the spring with the maximum population. If, for example, the room for breeding is not provided in the fall, it becomes necessary to handle the colony early in the spring, and this may be detrimental. Similarly, it is the practice of some beekeepers to add to the stores of the colony in the spring, rather than to leave enough in the fall to last until new honey comes in. This is dangerous for two reasons: Too often the stores are not given on time or in adequate quantity, and frequently they can not be given without exposing the colony too greatly. It is therefore the best practice by far to provide all of these factors in the fall, and no other methods are so safe and certain of success. By practicing the methods here given the enormous annual loss of colonies in winter may be almost entirely eliminated, and, what is more important, much stronger colonies may be obtained for the early sources of honey.

NECESSITY FOR STRONG COLONIES IN THE FALL.

A common cause of loss is through attempting to winter colonies that are too small. It is somewhat difficult to set a standard for colony strength at this season, but in general it may be stated that it is unwise to attempt to winter colonies that are not strong enough to have brood sufficient to fill three to four Langstroth frames two months before the packing is applied. If the colonies in the apiary are not of the proper strength it is wise to unite until the proper strength is reached. Any uniting should be done at least two weeks before packing. There is a tendency in some localities for colonies to weaken rapidly in early fall, due to the nature of the honey-flow from fall flowers. To some degree this may be offset by putting on the packing earlier than otherwise would be necessary.

It is highly important that each colony have a vigorous queen in order that brood-rearing may continue in the fall and may proceed rapidly in the spring. With colonies such as are obtained by the methods here described it is not desirable to keep queens more than two years and it is preferable to requeen the entire apiary every season. To get the best results in requeening all young queens should be introduced so that they will begin laying two months before packing. It will be found that queens wear out more rapidly in the unusually strong colonies obtained by the methods of wintering here described, but every good beekeeper realizes that it is these enormous colonies which get the greatest crops.

ARRANGEMENT OF THE APIARY.

WIND PROTECTION.

It is of the greatest importance that the apiary be located where the wind in winter is virtually eliminated. A grove of trees or an adjacent hill usually offers the best protection, or it is possible to make an artificial windbreak such as a high fence. A natural windbreak usually is better, for it is more extensive in most cases. It has been found by the authors that if a wind of 20 miles an hour blows on the winter packing cases for a few hours the temperature of the inside of the packed hive may be greatly reduced and may even fall as low as that of an unpacked hive. Too much reliance should not be placed in buildings as windbreaks, for they often serve simply to divert the wind slightly and may even make conditions worse. A fence made of close boards usually is unsatisfactory for it causes whirls that may destroy many colonies. A heavy blanket of snow serves to reduce the effect of the wind.

ARRANGEMENT OF THE HIVES.

In arranging the hives in an apiary it is necessary to take into account the method of wintering to be followed. If the bees are to be wintered in the four-colony cases to be described later the hives should be kept in groups of four all the season (fig. 1), for if colonies are moved more than a foot just before packing and then moved again as they are unpacked there is a considerable amount of "drifting"—that is, bees from some colonies join other colonies during flight, and the result is an actual reduction of the number of colonies and of bees in the apiary. A failure to keep the colonies properly arranged for their winter stands during the entire summer is a common cause of failure in using the four-colony cases. Whatever type of case is used for outdoor wintering, the bees should occupy the same place during the entire year.

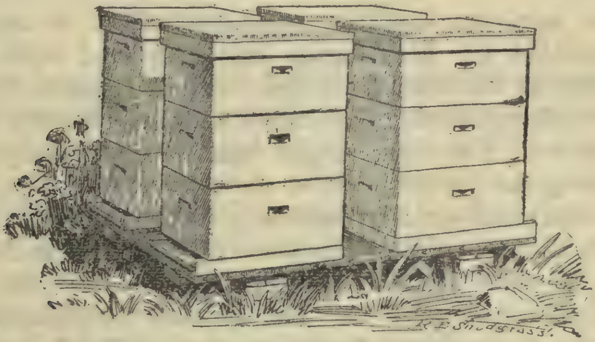


FIG. 1.—Colonies of bees in summer position in groups of four. This arrangement is advantageous whether or not the bees are wintered in four-colony packing cases.

Since the outside of the winter case is quite different in appearance from the hives the bees often are somewhat confused. To prevent drifting from this cause it is a good plan to set a large stake between the two entrances on each end of the four-colony winter cases; this will serve to help the bees in orienting themselves during flights in winter and especially in spring. If it is possible to plant some shrubbery among the hives it is a good plan to have the plants arranged so that they will act as markers for the bees during these early flights (fig. 3). They will not be amiss during the summer, and, if properly placed, they need not interfere with movement through the apiary during the summer's work, while they add to its attractiveness.

INSULATION OF THE HIVE.

AMOUNT OF PACKING NEEDED.

It is impossible to insulate bees too heavily during the winter. It is obvious, however, that the beekeeper will not want to put on more packing than is practically necessary. For a climate such as that of Washington, D. C., it is found desirable to provide 4 inches of packing underneath the hives, 6 inches on all sides, and 8 or more inches on top. In warmer climates less will be needed, but the beekeeper must not think that simply because he lives south of Washington he can be safe with less packing or none at all. There are many places farther south than Washington where more packing is needed, and there are, indeed, few places except along the Gulf or in southern California where less may be used if the best results are to be obtained.

For more northern localities more protection is needed. The amount indicated for Washington has been used with success in places as cold as northern Ohio and even in Canada, but in these places the insulation during the coldest seasons is usually augmented by heavy snows. These are not at hand every winter, or may be lacking during the coldest part of the winter, and it is, therefore, wise to provide more packing, especially on the sides and top. For a climate such as that of New York or Wisconsin, 8 inches of good packing on the sides and 1 foot on the top probably will be enough for good wintering every year. The amounts recommended for the different zones of the United States are given in Table I (p. 15).

A belief is current among many amateur beekeepers that good results may be obtained by using hives which have 2 inches of packing built in the sides and somewhat more on top. This amount is insufficient in winter in all parts of the country except the southern portions of the Gulf States. A common practice is to wrap some straw or corn fodder around the hives, but this may do more harm than good if the wind can blow directly through it. A covering of roofing paper with perhaps a little paper packing underneath is practically worthless in insulating value.

TYPES OF PACKING MATERIAL.

There is little difference in the insulating value of the various materials which may be obtained easily for the packing of hives in winter. Exaggerated claims have been made by some beekeepers for such materials as broken cork or certain commercial insulating materials, but it is safe to say that there is not 25 per cent difference between the poorest and the best of the available insulating materials, provided, of course, that obviously poor things such as corn fodder and straw be eliminated. Sawdust, fine planer shavings, forest leaves, chaff, broken cork, and such materials may be used, the choice depending chiefly on the availability of the materials. In general it may be stated that the smaller and the more numerous the dead air spaces confined in the packing, the greater will be its efficiency in insulation. If forest leaves are used they must be gathered the year before and stored, as the leaves fall some time after the bees should be packed. If sawdust is used it is best not to pack it down tight, but if forest leaves or planer shavings are employed it is essential that they be packed in closely and that the containers be completely filled. Broken cork, such as is used in the shipping of certain types of grapes, is good and has the advantage that it does not hold moisture as does sawdust. In all cases the packing should be placed in some sort of box which will be rain-proof and thus protect the insulation from rains and snow, for all insulating materials lose part of their efficiency when wet.

BOTTOM PACKING.

There has been considerable discussion among beekeepers as to the value of placing packing material below the bottom boards of the hives. This is usually provided by placing the hives on 2 by 4 inch supports or on racks of 4-inch material. Those who have opposed this have pointed out that "heat rises," overlooking the fact that while warm air attempts to rise, if this is impossible other avenues of escape of warm-air currents may be set up. Furthermore, and more important, they have overlooked the important fact that heat escapes from the hive not only by convection currents but by conduction and radiation as well. In an extensive series of experiments performed by the writers it was found that in hives packed at the top and sides most of the heat escapes through the bottom boards; in fact, this was so noticeable that the packing at the top and sides never served its full purpose so long as heat was escaping rapidly at the bottoms. It may be stated, therefore, that so long as the bottoms are unprotected there is little insulating value in materials piled on the top and sides beyond about 2 inches. This amount is insufficient for most parts of the United States, therefore bottom packing should be considered as absolutely essential wherever bees are packed.

To get the value of bottom packing it is absolutely essential that the entrance be reduced, but it need not be closed. In a long series of temperature readings on hives packed for several winters, the authors were able to keep a temperature of 50° F. on the bottom boards of packed hives directly behind the entrance openings. Those who have condemned bottom packing have labored under the mistaken notion that it is impossible to prevent currents of cold air through the entrance. This is entirely possible if the entrances are adequately reduced. The conclusion to be drawn from the experiments performed is that unless the bottoms of hives are well packed, the beekeeper ought not to imagine that he has packed his hives at all well.

THE PACKING CASE.

There is no virtue in any special type of case, but in all types there are a few points which must be observed. There must be provision for abundant packing on the top, bottom, and sides, the entrances must be small, the case must be rain-proof, and the construction of the case should be such that it may be taken apart and put together easily. The parts of various cases used in one series of apiaries should be interchangeable. The authors have refrained in the past from giving explicit directions for making a winter packing case for fear that some beekeepers might think that there may be peculiar virtue in the case used and recommended by the department (fig. 2). So many beekeepers, however, have written for exact dimensions for making the case used in the apiary of the Bureau of Entomology that it is considered best to give these in this bulletin.

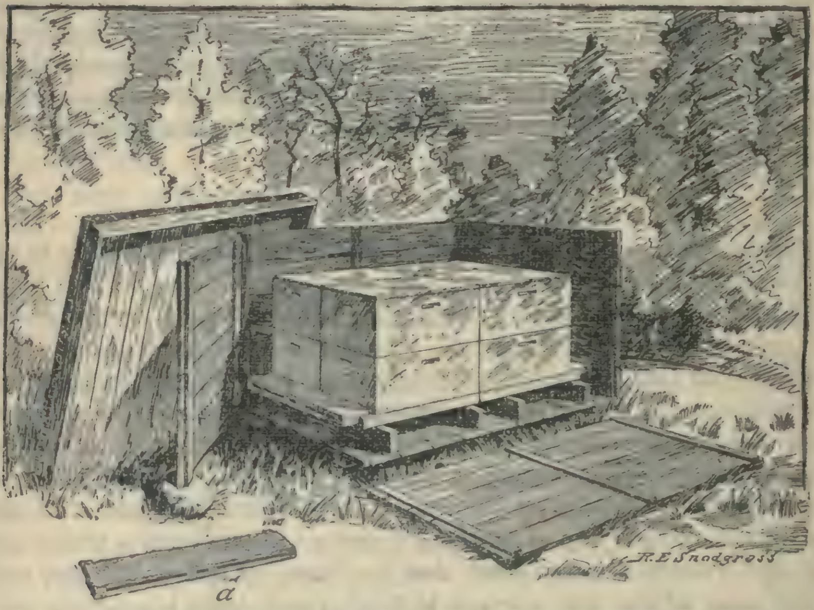


FIG. 2.—The winter packing cases used in the Bureau of Entomology apiary: *a*, Detail of tunnel to hives. In the specifications given in this bulletin (p. 9) provision is made for room for a third hive body to be added in the spring.

In order that protection adequate for bees in a climate such as that of Washington may be provided, 4 inches of packing below the bottom board, 6 inches on all sides, and at least 8 inches on top are desired. There is advantage in packing several colonies together, in order that they may warm each other and to reduce the cost of the case and the labor of putting it on. The bureau, therefore, has adopted the four-colony type of case which has been much used for years in all parts of the country. In this case, two colonies face east and two west. Provision is made for wintering all colonies in two full-depth hive bodies.

In the following dimensions it is assumed that $\frac{13}{16}$-inch tongued-and-grooved lumber is used, that the 10-frame Langstroth hive is in use, and that two hive bodies are employed for each colony, with adequate space above the hive so that, if needed, a third hive body may be put on before time for the removal of the packing. In this packing case the sides overlap the ends. For hives of other sizes the lumber must be cut so as to provide the packing specified in Table I (p. 15). For zones F and G (fig. 5) provision should be made for additional packing by increasing the length of all parts 4 inches, and for zone C a correspondingly smaller case may be made.

Bottom of case	44 inches (exact) by 52 inches (exact).
Sides of case	$53\frac{5}{8}$ inches (exact) by $35\frac{3}{8}$ inches (minimum).
Ends of case	44 inches (exact) by $35\frac{3}{8}$ (minimum).
Telescope cover of case	48 inches by 56 inches (minimum).

If 6-inch boards (laying $5\frac{1}{2}$ inches) are used, it is desirable to use 7 boards for the height of the case; if 8-inch boards (laying $7\frac{1}{2}$ inches) are used, 5 will be sufficient. In figure 2 only 6 boards, laying $5\frac{1}{2}$ inches, are shown, but in this case no allowance is made for a third hive body in the spring. For the telescoping part of the cover, 4-inch boards are used.

As was pointed out earlier, the hives should rest throughout the summer on the floor of the winter case (fig. 1). The plan of putting them in groups of four, two facing east and two west, has much to commend it during the entire year. The bottom therefore should be made strong enough to stand the weight of four colonies without getting out of shape. Since this weight may be over 1,000 pounds in a good year, it is advised that the cleats on the bottom of the case be of 2 by 4 inch material. The supports of the bottom and the position of the cleats should be arranged so that the weight will not rest too largely on the boards, and the stones or bricks used should be directly under the center of the hives when they are in their summer position. Obviously the hives will be moved to the outer corners of the bottom during the summer to facilitate handling.

The sides of the case should be so constructed that the cleats which hold the boards together will serve to support the overlapping sides on the bottom. This is clearly shown in figure 2. There should also be a central cleat on the sides to prevent warping, for the cases must be rain-proof. If cleats are properly placed as shown in the illustration, they make the equivalent of a halved joint at the corners. The sides may be held in place and together by nails or by any sort of special hook. The entrances for the colonies during winter should be in the ends of the case, as shown. These will be discussed later.

The top of the case may be made to telescope over the sides, as shown in figure 2, or it may be made in any other way desired so that it is adequate to keep the packing absolutely dry throughout the winter. The telescope cover has much to commend it, especially in the ease with which the covers may be stored in summer. The top of the wooden cover should be covered with a roofing paper of first quality in order that the protection will last for years. If the telescope type of cover is used, no cleats other than the sides and ends of the telescoping portion will be needed.

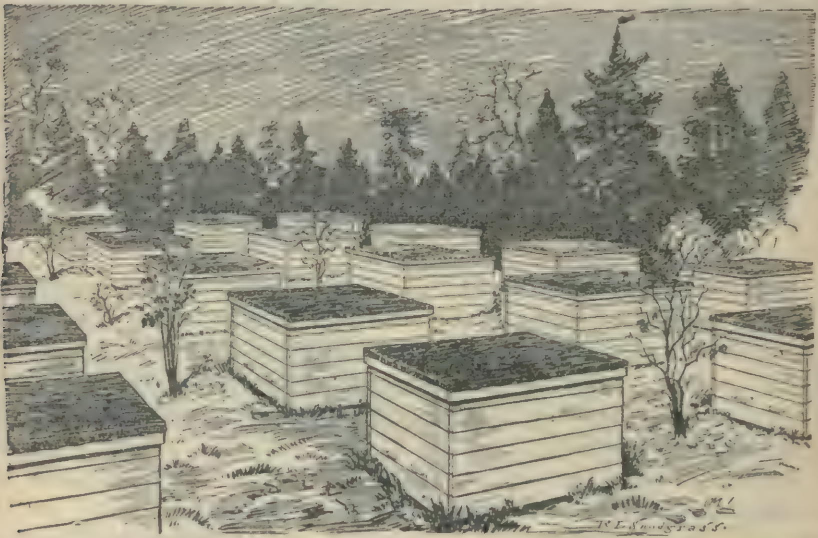


FIG. 3.—An apiary packed for winter in four-colony cases such as are used in the Bureau of Entomology apiary.

A tunnel (fig. 2, *a*) is also needed through which the bees may pass on warm days and to permit ventilation. This is best made of two boards, one the width of the packing (e. g., 6 inches) and the other this width less the extension of the bottom board. In most cases this extension is 2 inches, so the lower board will be 4 inches wide. These are held apart by strips three-eighths of an inch thick. This is the height of the usual hive entrance in winter, and the passage between the boards is therefore the same height as the hive entrance. In order that the tunnel may not get out of alignment, these strips are continued back, as shown in the figure, and these projections extend into the hive entrances at the corners. The arrangement for keeping alignment at the outer edge is discussed under "The entrance" (p. 13).

SINGLE OR DOUBLE CASES.

For those having only a few colonies, it is not always convenient to build cases for colonies in groups of four. It is not necessary to give dimensions in detail for those having a few colonies, however, for they will usually wish to use whatever they have at hand. It is often possible to arrange a heavy wooden box, such as those used for shipping dry goods (fig. 4), so as to make a winter case for one colony which will answer every purpose. It is, of course, necessary that the salient feature of a good winter case be preserved. If the arrangement of the apiary makes it inconvenient to have the colonies in groups of four throughout the year, it is quite possible to make good cases for two colonies. Anything other than the four-colony case, however, will probably cost more per colony, or if too many colonies are put into larger cases there may be trouble from other causes, as from drifting.

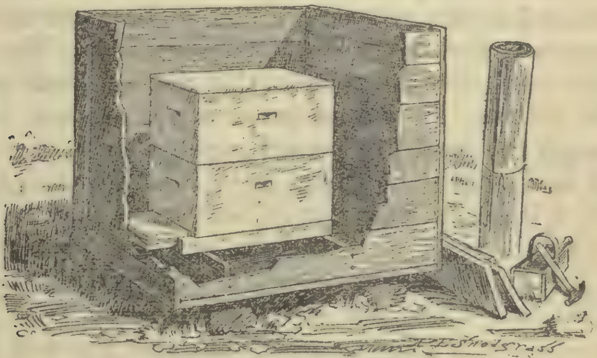


FIG. 4.—An improvised winter case for one colony.

ARRANGEMENT WITHIN THE HIVE.

CAPACITY OF THE WINTER HIVE.

As has been pointed out, bees need room for breeding in the fall and again in the spring. During the winter season there is no brood-rearing in normal colonies which are adequately protected, and room for breeding therefore is not essential during the winter. If the bees are to have room for the proper development of colony strength, however, they should have two hive bodies each of 10-frame Langstroth size by about the beginning of April in most parts of the country, and earlier in the South. In order that it may be unnecessary to open colonies during a period of such unsettled weather as obtains at this season, it is advised that the room for breeding be provided in the fall and left with the bees all winter. To make this a safe procedure, it is necessary to provide more packing than would be necessary if the colony were provided with only enough room for the cluster and winter stores during the winter. It has been found desirable also to leave more stores with the bees than have been left by many beekeepers, and this is additional reason for the giving of more room during the winter.

It is recommended, therefore, that in all parts of the United States colonies of full strength be wintered in two hive-bodies of 10-frame Langstroth size. They should, of course, be provided with abundant protection and the entrances should be reduced

SPACE ABOVE THE FRAMES.

Formerly it was commonly recommended that corn cobs, or other objects designed for the purpose, be placed above the top bars of the frames, and then that quilts be placed over these. The purpose of these objects was to lift the quilts so that the bees could pass over the tops of the frames. In former years it was advised that holes be bored through the combs to permit passage from one space to the other. Of late years these things have been abandoned, to a large degree, for it is known now that if bees are packed as they should be they may pass easily at all times to any part of the hive as need arises. It is often stated that bees die of starvation in the hives when there is abundant honey not many inches away from the cluster. This, of course, never happens in colonies that are well packed. In colonies that are adequately protected there is no better plan than simply to leave the regular wooden cover in place and sealed down by the bees. Quilts directly over the frames are a nuisance at any time, and during the winter they are of no value for upward ventilation in well packed colonies and should be used only as a poor makeshift for good packing.

UPWARD VENTILATION.

A common practice has been to remove the hive cover when the bees are packed for winter and to cover the frames with burlap or some such porous material, the object being to allow the escape of any moisture which may be generated within the hive during the winter. Moisture is being generated constantly as the bees consume the honey stores, but if the bees are adequately packed the amount of moisture will be reduced to the minimum. The chief danger, of course, is from moisture which condenses, and in an adequately packed hive there is no condensation. The temperature never goes low enough for water vapor to condense. Therefore it is obvious that upward ventilation for the escape of moisture is never needed in hives that are packed as they should be. Any beekeeper who has had trouble in the past with condensed moisture in the hives, or with wet packing over the porous tops, may be sure that he has not provided enough packing material.

Another thing is to be considered in connection with the subject of upward ventilation. The entrances to the hives must be greatly reduced in order that there may not be excessive loss of heat at that point. If upward ventilation is provided, there is opportunity for the wind to blow through even the small entrance, through the hive and out through the porous cover. This current of air will be slight but nevertheless it exists, and serves as an avenue for the escape of considerable heat.

If insufficient packing is provided, upward ventilation becomes almost necessary, unless a large entrance is left. The beekeeper must see to it that he is providing adequate packing material before he gives up the upward ventilation, but he should not count his bees well packed for winter so long as he must provide for the escape of condensed moisture.

THE ENTRANCE.

As has been pointed out, the entrances of hives must be greatly reduced during the winter in order that the efficacy of the bottom packing may be preserved. It is desirable, however, that provision be made for larger entrances during the early fall and again in the spring. To provide conditions suitable at all times while the packing cases are on, the Bureau of Entomology has adopted a type of entrance which to some extent has been used previously in the North. Five $\frac{3}{8}$-inch auger holes are bored in the ends of the packing case at a height that will allow for the thickness of the case floor, the bottom packing, and the thickness of the bottom of the hive. This usually is a little over 6 inches from the lower edge of the case ends. No alighting board should be placed at the outer entrance holes, as it is not needed and serves only to collect snow and ice.

To prevent the tunnels from getting out of alignment at the outer edge, a peg of the diameter of the holes is inserted through the outer hole for each hive and into the tunnel (see fig. 2). This peg is usually about 2½ inches long. This leaves four auger holes, each three-eighths of an inch in diameter, for the bees to use as an entrance during the fall and spring, and during the colder weather a piece of section material or a small board is tacked over three of the holes. (See fig. 3.) This gives in winter a single hole for an entrance, three-eighths of an inch in diameter. This provides a place for the bees to remove their dead, a place for flight on moderately warm days, and also provides adequate ventilation for the hive while the bees are confined without an opportunity for flight. However, the size of entrance should not be discussed without warning beekeepers that unless adequate packing is provided, such a small entrance may result in the death of the colony. Furthermore, a poorly packed colony will not be able to carry out the bees as they die, and the death rate will be higher; and these things combined may result in an accumulation of dead bees at the entrance, which will serve to suffocate the remaining bees. A colony that is well packed, however, is able to remove all dead bees as fast as they die, and there will never be an accumulation on the floor of the hive. Furthermore, a well-packed colony does not need so large an entrance for ventilation as does one that is not packed or which has not enough packing. If snow drifts over the small entrance here described, the beekeeper need have no anxiety, for the bees can still receive adequate ventilation. If a crust of ice closes the entrance it will be well to break it, but usually the escaping heat will melt this ice before any damage is done.

WINTER SCHEDULE.

Great confusion has existed among beekeepers as to the right time to pack the bees for winter, and especially as to the right time to remove the packing in the spring. It is quite possible to give definite directions for both procedures and to place the recommendations on a firm foundation by basing them on weather phenomena. The maps (figs. 5 and 6), showing the time of the first average killing frost in the fall, serve as a basis for the recommendations for each

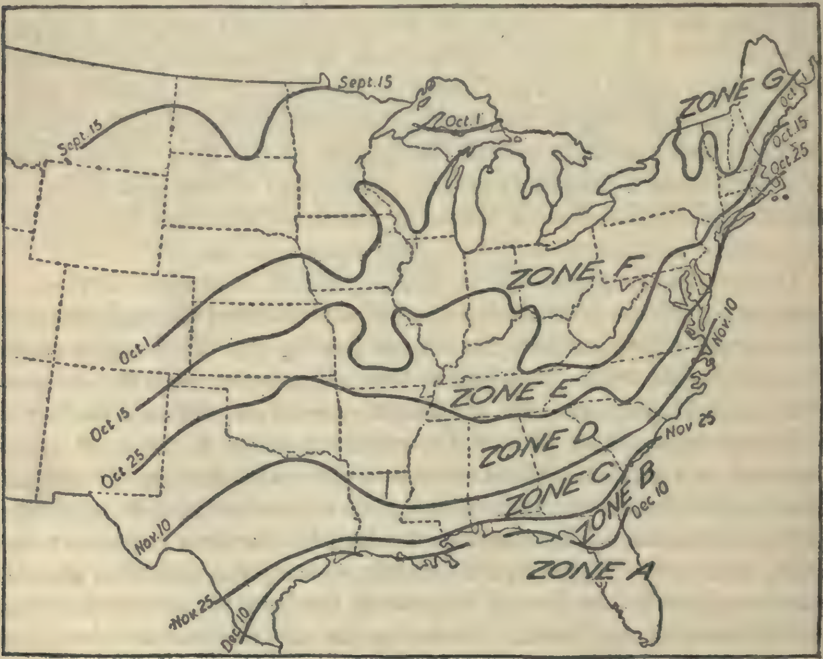


FIG. 5.—Map of the eastern United States indicating average date of first killing frost in autumn. On this the zones for winter packing are based. No packing is recommended in zones A and B.

of the zones into which the map of the eastern United States is divided. Perhaps it will be a matter of surprise to beekeepers in parts of the South to see that, so far as the wintering of the bees is concerned, they are as far north as beekeepers who live many miles farther toward the pole.

The lines on figure 5 indicate the average dates of the first killing frost in the fall, and these dates, given at the ends of the heavy lines, are of direct value to the beekeeper as giving the proper time for putting on the winter cases. The average dates of the last killing frost in the spring do not show exactly the same lines on the maps, but the differences are not sufficiently great to justify the use of a separate map for this purpose. The authors have chosen therefore to divide the country into the zones indicated, and the recommendations given below apply to each of the zones shown.

On account of the variations in elevation, it is impossible to carry these lines into the Rocky Mountain region, but as packing is just as necessary in the West as in the East, figure 6 is inserted to indicate roughly the time for the putting on of the packing in the fall. The dates in this map are the average dates of the first killing frost. By consulting Table I the beekeeper of the West may learn the time advised for the removal of the packing, by placing his locality in its proper zone, on the basis of the first killing frost.

TABLE I.—*Dates for the packing and unpacking of bees in the various parts of the United States, based on data furnished by the Weather Bureau for the average dates of the first and last killing frosts. The amount of packing recommended for each zone is included.*

Zone.	Date for packing.	Date for unpacking.	Packing recommended.[1]	Remarks.
A				None needed.
B				Do.
C	November 25	March 15	2-4-6	
D	November 10	April 10	4-6-8	
E	October 25	May 1	4-6-8	
F	October 1	May 20	4-8-12	
G	September 15	June 1	4-8-12	Cellar wintering much safer.

[1] In this column the first figure represents in inches the amount of packing needed below the bottom boards, the second the amount of side packing, and the last the amount needed on top.

TIME FOR PUTTING ON THE WINTER PACKING.

Frequently great loss of colony strength is due to delay in putting on the packing. Perhaps this is the most common source of loss in outdoor wintering aside from that due to a failure to pack the bees at all. Packing should not be deferred after the flowers furnishing the last honey are killed by frost. In case the late fall flowers furnish honey that is to be removed, then it is necessary to wait until nectar is no longer coming in before applying the packing, but it is indeed rare that the last honey should be taken away, and it is good beekeeping to apply the packing even before there is any frost at all. The determining factor is the necessity for handling the bees.

If more stores must be given them or if some of the late honey is to be removed in order that it may be replaced by better honey or by sugar sirup, then handling of the bees after frost may be needed, but after the last essential handling it is much the best plan to pack the bees. In parts of the country where bees are wintered outdoors it is quite customary to delay packing until Thanksgiving Day, but this is too late by far except in the extreme South (zone C).

It is safe, therefore, for the beekeeper to use the dates shown in figures 5 and 6 and the data given in Table I as a guide to the time of packing. He may be assured that if he delays packing later than the dates shown therein the bees will suffer by a loss of colony strength and vitality at a season of the year when they can ill afford to be weakened by neglect. Under no circumstances should packing be delayed more than two weeks after the date given for each zone. Further, if packing is delayed until after cold weather begins, the disturbance of the colony may induce the beginning of brood-rearing, and this in turn may result in the death of the colony. If by chance a colony has been left unpacked until after the bees have been confined by cold weather for three or four weeks, the packing may do more harm than good.

TIME FOR THE REMOVAL OF PACKING.

If bees are given the right amount of room, stores, and protection early in the fall, nothing that the beekeeper can do will benefit them until it is necessary to handle them because of preparations for swarming or because of the incoming nectar. Of course if bees are well packed they get so strong in the spring that if crowded they begin preparations for swarming earlier than do colonies which have been neglected during the winter. By following the methods here described the season for swarm control is advanced, so that usually it is entirely passed before the honey-flow begins.

In the region of Washington it has been found best not to remove the packing until at least May 1. Farther south or in warmer regions it may be well to remove the packing earlier, but in localities such as New York or Wisconsin (zone F) the packing should be left in place until at least May 20, and usually until June 1. Obviously this will be impossible unless two hive bodies are left on the bees all winter, or unless more room is given in the early spring, before unpacking. It has been found that if the bees are allowed to remain in the cases until the dates named they may then be taken out ready for whatever nectar may come. By that time they should have 12 frames of brood—far more than is found in the average colony throughout the country even in the midst of the honey-flow. Such colonies are so strong that if cooler weather comes after they are unpacked, as it sometimes does, they are not injured by it. Of course the bees would be as well or even better off if the packing

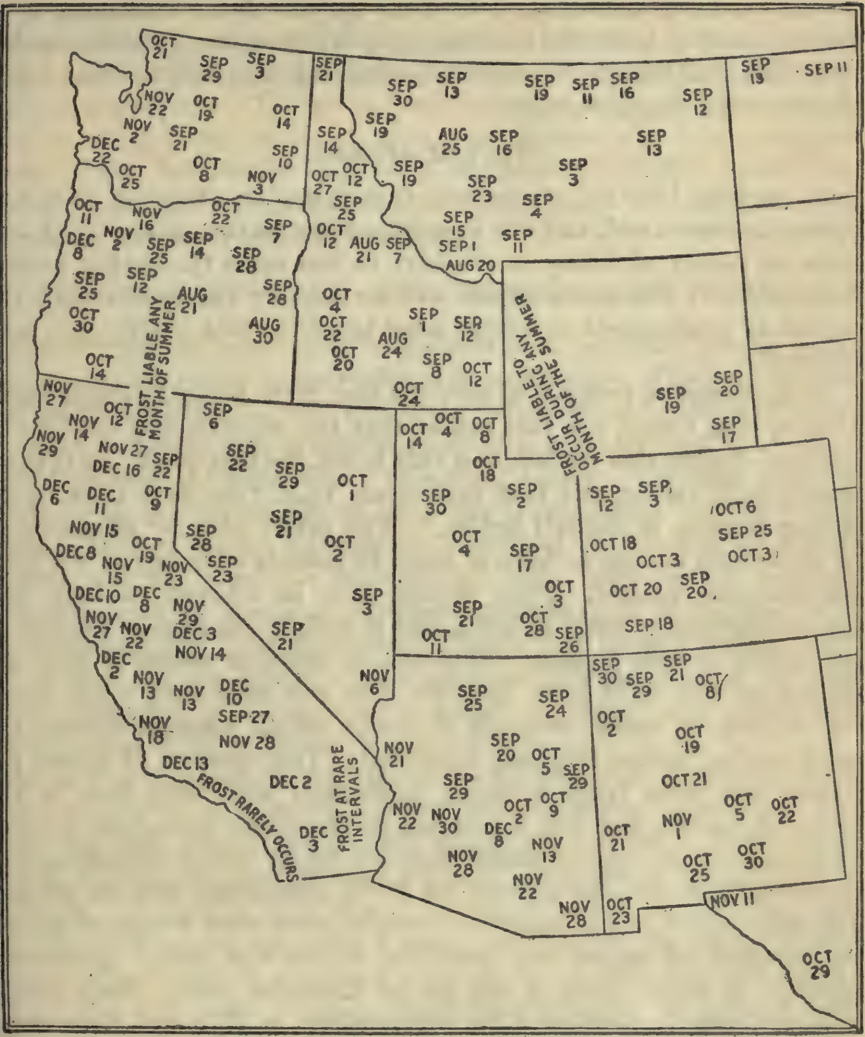


Fig. 6.—Map of the western United States, showing variation in average date of first killing frost. For each locality the recommendations for packing and unpacking are the same as in corresponding zones in figure 5. The dryer atmosphere of most of the West does not diminish the need of packing. For localities where the first frost occurs after November 25 no packing is recommended.

could be left on throughout the year, but as yet no practicable way has been devised for giving the bees enough packing during the winter and then leaving it on throughout the summer. The commercial double-walled hives which have been devised for this purpose are all too scant in packing material for good results, and none of them can be recommended.

The dates given for the removal of packing in the spring follow approximately the average dates of the last killing frost in the spring for each locality. In case local conditions make the removal of the packing unnecessary as early as the dates indicated, it is entirely safe to leave the packing on until some manipulation makes it desirable to handle the combs, as this can not well be done while the hives are heavily packed.

WINTER STORES.

In packing bees for winter two things require attention so far as stores are concerned, and one is as important as the other: (1) There must be plenty of honey in the hive to last until the spring honey-flow, and (2) the stores which will be used by the bees during the period of confinement in winter must be of the best quality and well ripened.

It is, of course, possible to give the bees more honey or sugar sirup after spring opens, but this means that the colonies will need to be handled during this period, and this is not the best plan. It is commonly said among the best beekeepers that "the best time to do spring feeding is the fall before." The safest plan by all means is to allow each colony to have at least 45 pounds of honey at the time the bees are packed. They should then be allowed to keep any honey which may come in later, and it will be adequately ripened if the colony is well packed. This will be small in extent if they are packed at the right time, and the bees will also have their stores replenished by small amounts of honey which come in during the early spring before they are unpacked. This amount of stores for winter will seem large to many beekeepers who have been in the habit of leaving less, but the object of the plans herein set forth is to have much stronger colonies than are found in the average apiary in the spring, and the amount of stores mentioned may be needed. The only places where beekeepers might have some reason to reduce the amount of stores are locations where the honey granulates quickly, in which event it can not be extracted later. Such honey, however, usually is as good for winter stores as if it were not granulated, and it may then be saved for stores the following winter. Forty-five pounds of honey on the hive is a better investment for the beekeeper than money in the bank, and more beekeepers make mistakes in this regard than anywhere else in the work of the year.

Honey that is high in gums, as many of the honeys which come from various trees, is not good for winter stores. Honeydew honey is still less desirable. When either is present it is best to remove it and either to give frames of good honey to take its place or to feed about 10 pounds of good honey or sirup made of granulated sugar after all brood-rearing has ceased. Honey or sugar sirup which is fed late is stored in the place where the last brood emerged; it is therefore the first of the stores that the bees use. As long as they are having good honey or sugar stores for winter use the condition known as dysentery will be warded off. Then, later, when they have used up the good stores, the weather will permit frequent flights, and then the less satisfactory stores will do no harm. Honeydew honeys usually may be detected by their bad taste, accompanied ordinarily by a dark, muddy appearance. In case of doubt as to the stores it is always safe to give good honey or sugar sirup. Unfortunately it is true that many of the fall honeys are not of the best quality for winter use, and this, in part, accounts for the heavy losses of bees occurring regularly in some parts of the country.

ALL THE FACTORS OF GOOD WINTERING ARE NEEDED.

One frequently encounters beekeepers who condemn winter packing, stating that they have tried it without success. The writers have met many such beekeepers, and many of them are good beekeepers in other respects. On careful inquiry it is learned that in all cases they have omitted some vitally important factor. The most common fault in winter packing is to leave the entrances of the hives wide open. This, of course, nullifies the benefit of the packing to a large degree, and one need not be surprised that these men do not find virtue in packing heavily. Another common fault in packing is to omit the packing from the bottom. Snow acts as an excellent insulation, but one can not be sure that there will be snow at just the right times, and it is therefore necessary, to insure good wintering, that good packing be placed on the bottoms.

It is also common to face the hives to the south and then leave the fronts without packing, under the erroneous impression that since the heat from the sun will enter more readily, the colonies will be benefited more than they would be if they were heavily packed in front. To combat this view it should be necessary only to point out that the sun shines only a small fraction of the hours during winter. Furthermore, any place through which heat may enter easily serves also as a place through which heat escapes. In certain well-known cases the other factors of good wintering, strong colonies and good stores, are so well provided that the loss from this lack of protection is not detected, yet it is certain that in any such method of wintering there is a great loss of bee vitality, and the bees are compelled to do more work in heat generation than would be the case were they well packed.

It can not be stated too strongly that the right way to winter bees is to provide *all* the factors needed, and not to omit any of them simply because in most years the bees can get through without all dying when less help is given. The three things necessary for successful caring for bees from the time they are packed until they are unpacked in the late spring are (1) plenty of protection, (2) plenty of stores of good quality, and (3) plenty of room for the building up of the colony strength in the spring. None of these may be omitted without reducing the colony strength in the spring, and, as every good beekeeper knows, it is the strong colonies which get the maximum crop.

MEASURES OF SUCCESS IN WINTERING.

It is often difficult for a beekeeper to know whether he is wintering his bees as well as he should, for he may not have been able to learn from reading or visiting other apiaries how well colonies may be brought through the winter. The writers therefore have attempted to give here a few measures which the beekeeper may apply to his apiary, that he may be able to decide whether his methods of wintering should be improved.

1. When bees are adequately packed and protected from the wind, they are able to push out the dead bees as they die in winter. There should never be an accumulation of dead bees on the bottom board.

2. A colony of full strength will have 12 Langstroth frames filled with brood by the time that the bees should be unpacked. The bees should not be taken from their cases until it is necessary to handle them, and if two hive bodies have been given each colony, unpacking may be deferred until time for the control of swarming or until the new honey is coming in freely. Sometimes it even happens that colonies need a third hive as a swarm prevention measure before it is time to remove the packing, in which case it can be given and the packing replaced, at least around the sides of the third hive body. Space for this is indicated in the dimensions given on page 9.

3. A colony is not of proper strength for winter unless it has between three and four frames of brood two months before the time for putting on packing. Usually this will be six weeks before brood-rearing ceases. If there is less brood at that time it indicates either that the queen is not good or that the colony has been weakened from some other cause. If taken in time this condition may be remedied by adding brood or honey or by uniting. It is extravagant to attempt to winter weak colonies.

4. If a thermometer is inserted into the hive through the auger hole entrance at the time of the coldest weather in winter it should show a temperature above the freezing point. At no time should the temperature of any part of the hive go below freezing, and the point just within the entrance is the most convenient one at which to take the temperature readings. The lowest temperature obviously will be at this point.

THE PRESIDENT TO THE FARMERS OF AMERICA.

[Extracts from President Wilson's message to the Farmers' Conference at Urbana, Ill., January 31, 1918.]

The forces that fight for freedom, the freedom of men all over the world as well as our own, depend upon us in an extraordinary and unexpected degree for sustenance, for the supply of the materials by which men are to live and to fight, and it will be our glory when the war is over that we have supplied those materials and supplied them abundantly, and it will be all the more glory because in supplying them we have made our supreme effort and sacrifice.

In the field of agriculture we have agencies and instrumentalities, fortunately, such as no other Government in the world can show. The Department of Agriculture is undoubtedly the greatest practical and scientific agricultural organization in the world. Its total annual budget of $46,000,000 has been increased during the last four years more than 72 per cent. It has a staff of 18,000, including a large number of highly trained experts, and alongside of it stand the unique land-grant colleges, which are without example elsewhere, and the 69 State and Federal experiment stations. These colleges and experiment stations have a total endowment of plant and equipment of $172,000,000 and an income of more than $35,000,000 with 10,271 teachers, a resident student body of 125,000, and a vast additional number receiving instructions at their homes. County agents, joint officers of the Department of Agriculture and of the colleges, are everywhere cooperating with the farmers and assisting them. The number of extension workers under the Smith-Lever Act and under the recent emergency legislation has grown to 5,500 men and women working regularly in the various communities and taking to the farmer the latest scientific and practical information. Alongside these great public agencies stand the very effective voluntary organizations among the farmers themselves which are more and more learning the best methods of cooperation and the best methods of putting to practical use the assistance derived from governmental sources. The banking legislation of the last two or three years has given the farmers access to the great lendable capital of the country, and it has become the duty both of the men in charge of the Federal Reserve Banking System and of the Farm Loan Banking System to see to it that the farmers obtain the credit, both short term and long term, to which they are entitled not only, but which it is imperatively necessary should be extended to them if the present tasks of the country are to be adequately performed. Both by direct purchase of nitrates and by the establishment of plants to produce nitrates, the Government is doing its utmost to assist in the problem of fertilization. The Department of Agriculture and other agencies are actively assisting the farmers to locate, safeguard, and secure at cost an adequate supply of sound seed.

The farmers of this country are as efficient as any other farmers in the world. They do not produce more per acre than the farmers in Europe. It is not necessary that they should do so. It would perhaps be bad economy for them to attempt it. But they do produce by two to three or four times more per man, per unit of labor and capital, than the farmers of any European country. They are more alert and use more labor-saving devices than any other farmers in the world. And their response to the demands of the present emergency has been in every way remarkable. Last spring their planting exceeded by 12,000,000 acres the largest planting of any previous year, and the yields from the crops were record-breaking yields. In the fall of 1917 a wheat acreage of 42,170,000 was planted, which was 1,000,000 larger than for any preceding year, 3,000,000 greater than the next largest, and 7,000,000 greater than the preceding five-year average.

But I ought to say to you that it is not only necessary that these achievements should be repeated, but that they should be exceeded. I know what this advice involves. It involves not only labor but sacrifice, the painstaking application of every bit of scientific knowledge and every tested practice that is available. It means the utmost economy, even to the point where the pinch comes. It means the kind of concentration and self-sacrifice which is involved in the field of battle itself, where the object always looms greater than the individual. And yet the Government will help and help in every way that it is possible.

It was farmers from whom came the first shots at Lexington, that set aflame the Revolution that made America free. I hope and believe that the farmers of America will willingly and conspicuously stand by to win this war also. The toil, the intelligence, the energy, the foresight, the self-sacrifice and devotion of the farmers of America will, I believe, bring to a triumphant conclusion this great last war for the emancipation of men from the control of arbitrary government and the selfishness of class legislation and control, and then, when the end has come, we may look each other in the face and be glad that we are Americans and have had the privilege to play such a part.

THE BUSINESS OF AGRICULTURE.

[Extracts from addresses.]

The next great factor to enlist for the betterment of Agriculture and rural life in this Nation is the business man of the town and the city. He has not always been alive to his obligations. He has contented himself, in too many instances, with plans to secure profit in agricultural trade, instead of sympathetically and eagerly planning constructive assistance. This duty, pressing in peace time, is of the most urgent and impelling character in this crisis; and I appeal to the bankers and business men to see that they omit no effort to familiarize themselves with the agencies serving to aid the farmers and to promote wise plans to secure the necessary results.

D. F. Houston,
Secretary of Agriculture.

In the interest of our national development at all times and in the interest of war efficiency just now our agriculture must be well maintained. It should be remembered that the agricultural unit is a small unit. There are 6,000,000 farms in this country, each an individual unit. It is to the interest of persons who do not live on farms, even more than to the interest of those who do live on farms, that production shall be kept up. This means that all people, not farmers alone, but those who live in cities as well as the farmers, are interested in experimental and educational activities along agricultural lines as conducted by the Federal Government and the States. These efforts should be liberally supported.

R. A. Pearson,
Assistant Secretary of Agriculture.

In a time like this no man has a moral right, whatever his fortune may be, to employ another man to render any service of mere comfort or convenience. When the finest young men of the United States are in France digging ditches, sawing lumber, laying rails, and playing with death, and when the finest young women of the United States are scrubbing floors in hospitals, it is a sin that almost approaches the unpardonable offense against civilization for any man or women in the United States to engage in a wasteful or unnecessary service.

Clarence Ousley,
Assistant Secretary of Agriculture.

BEEKEEPING IN WARTIMES.

IT IS IMPERATIVE that the sugar crop of the United States be increased, and every supply of supplemental sweet should be augmented to the greatest possible extent. Honey is one of the best of these and its production may be increased without great effort. The supply of nectar from which the bees make honey is bountiful and the only limitation to honey production is whether the price obtainable for the honey justifies the labor of the beekeeper. There is no question of this in wartimes.

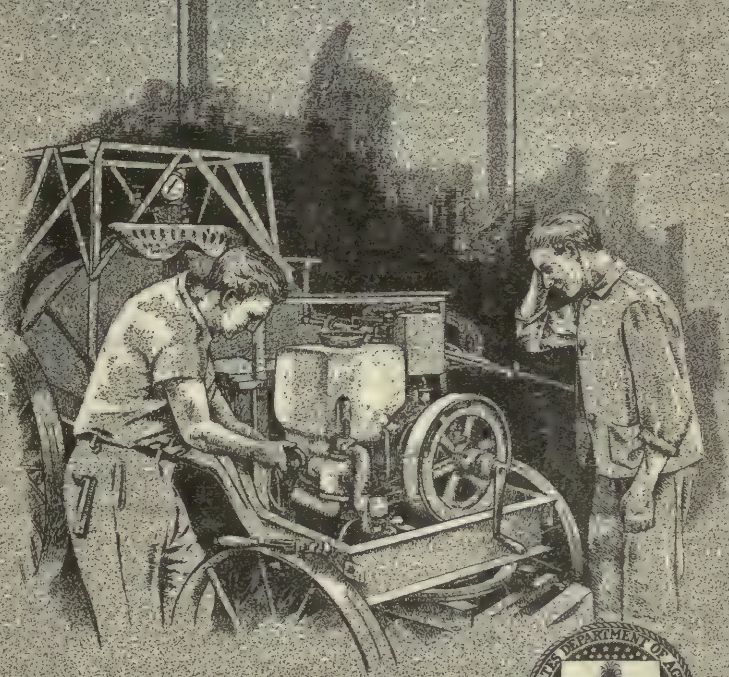
The recent demand for honey for export has been greater than ever before and the home demand has also greatly increased. Because of the shortage of sugar, all forms of supplemental sweets are being utilized and none of these appeals to the tastes of the consuming public more strongly than does honey. This increased demand has raised the price of honey and it is therefore a paying business to produce it to meet this need, in addition to the fact that the beekeeper may feel that he is materially assisting in the food crisis of the Nation. It is to be expected that even after the war is over this demand for honey will not cease, for many people are eating honey now who were not familiar with its delicious qualities, and they will not forget how good it is.

In the production of honey, it is of the first importance that the colonies of bees be kept strong, especially that they be strong before the beginning of the main honey-flows of the early summer. To bring about this essential condition, the most important step is the proper wintering of the bees, and this bulletin has been prepared that beekeepers throughout the country may be able to get their bees through the winter without the great loss of colonies and reduction in strength of those which still live which have been so common in the past. The proper preparation of the bees for winter now becomes not only a patriotic duty, but it is good business.

KEEP MORE BEES. KEEP BEES BETTER.

FARMERS' BULLETIN 1013
UNITED STATES DEPARTMENT OF AGRICULTURE

PRACTICAL HINTS ON RUNNING A GAS ENGINE



IN THIS BULLETIN: General suggestions to inexperienced operators of gas engines on how to avoid or remedy the more common forms of engine trouble.

Directions for making tests to locate trouble in the ignition system or the fuel system.

A discussion of various methods of starting in cold weather.

A "trouble chart," in which possible sources of trouble are listed, with brief outlines of measures that may be taken to remedy the trouble.

Office of the Secretary
Contribution from the Office of Farm Management
E. H. THOMSON, Acting Chief
Washington, D. C. January, 1919

PRACTICAL HINTS ON RUNNING A GAS ENGINE

A. P. Yerkes,
Assistant Agriculturist.

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NEEDLESS WASTE OF LABOR.

THE GAS ENGINE, a great labor saver on thousands of farms on which stationary engines, tractors, motor trucks, or automobiles are operated efficiently, is also at times the cause of a great waste of labor. Often large crews hired to help with thrashing, hay baling, cutting ensilage, etc., draw full wages for hours spent in idleness owing to inefficient handling of the engine. A man frequently will spend much more time and energy in starting a gas engine to pump water for stock, run a milking machine, or for some other similar purpose, than would be required to do the work by hand. The time lost throughout the country in this manner, enormous in the aggregate, is to a great extent preventable.

It is not desired to convey the impression that gas engines usually give trouble, or are difficult to operate, for this is by no means the case. Delays from engine trouble are usually due to the operator's ignorance of some of the details essential to proficient operation. The purpose of this bulletin is to assist in conserving farm labor by offering some practical help to persons whose duty it is to operate gas engines. It is not intended as a course of instruction for those totally unfamiliar with the principles of gas engine operation. The aim is merely to call attention to some of the more common causes of trouble with gas engines, suggest a method of locating quickly the seat of trouble when an engine fails to run as it should, and offer a sort of reminder in the form of a condensed trouble chart, which, it is believed, will frequently be of assistance even to the more experienced engine operator. The suggestions and information are general, no attempt having been made to make them directly applicable to each of the many types of engines.

NOTE.—Acknowledgment is due to Messrs. H. R. Brate, D. R. A. Drummond, and J. H. Mowry for valuable suggestions in connection with the publication of this bulletin.

USE ALL INFORMATION FURNISHED BY MANUFACTURER.

All catalogues and directions furnished by the manufacturer should be studied carefully. If none are received with the engine, a request for them should be sent promptly to the manufacturer. It is to be regretted that a few manufacturers are rather lax in the matter of furnishing such material, although it is obviously to their interest to make use of this comparatively inexpensive method of assisting the purchaser to obtain satisfactory service from the engine.

> **Any instruction book furnished by the manufacturer should be kept in a safe place, but convenient for reference.**

It is safe to assume that the man who made the engine knows something about its operation and can give some information of value to the purchaser. In altogether too many cases, the instruction book and other literature intended to be of assistance to the user of the outfit are either thrown away or ignored completely, and not infrequently a man is sent from the factory, or a local expert is hired, to make simple adjustments concerning which full instructions are given in literature furnished by the manufacturer but which had never been read by the owner.

LUBRICATION.

A large percentage of repair expenses is due to insufficient or improper lubrication. In far too many cases owners of gas engines use grades of oil entirely unsuited to their engines, notwithstanding the fact that in each case the manufacturer has furnished a long list of various brands and grades of oil which have been tested and found suitable to the engine in question, and which can be obtained practically anywhere in the country.

Another common error is to use too little oil. It is poor economy to try to save on oil. On the other hand, an excess of oil in the cylinder, while better than too little, will cause carbon deposits, followed by loss of power, overheating, and preignition. Heavy, bluish smoke from the exhaust indicates that the cylinder is getting too much oil, but it is usually advisable to furnish enough to give at least a slight trace of bluish smoke.

If the cylinder is oiled from the crank case by the splash system, the lubricant being used over and over again, the oil should be examined frequently, and as soon as it becomes badly discolored or very thin it should be drained out and new oil substituted. Many manufacturers furnish directions as to how often this should be done. Filling the crank case with kerosene after draining out old oil, and then running the engine a few minutes without load, in order to remove dirt and carbon from bearings and other parts, is frequently recommended. This is good practice where the crank case can be drained completely, but on many engines there are pockets which can not be fully drained, and the kerosene remaining in these pockets will thin the new oil. Under such circumstances the rinsing is of doubtful value. After such rinsing is done, the engine should not be run at full speed or under load until the new oil has had ample time to reach all bearings. The dirty oil drained off may be filtered and used for oiling other farm machines, but it should not be used again in the cylinder. If the oil in the crank case quickly becomes thin it is evident that some of the fuel is getting past the piston rings. This seriously affects the lubricating quality of the oil. It should, of course, be replaced with fresh oil, and steps taken to improve the carburetion so as to form a fuel mixture which will burn more completely.

KEEP ALL NUTS TIGHT.

It requires but a minute or two to go over an engine and see that all screws and nuts are tight, at the same time wiping off any oil and dirt which have collected. This should be done at least once every day the engine is used. Such practice will go far towards preventing many operating troubles, since all gas engines vibrate to some extent and this vibration tends to loosen bolts, nuts and other parts. This is always a potential source of breakdowns, if not of serious accidents. Furthermore, loosening of parts often results in a loss of power.

STOP, THINK—THEN FOLLOW A DEFINITE SYSTEM.

Everyone who operates a gas engine of any kind should learn first to stop and reason as to the probable cause of any trouble which develops.

In most cases where an engine stops, loses power, or indulges in some other irregularity, some indication of the cause will be apparent to anyone familiar with the outfit if he studies the problem intelligently. Such study will enable one to avoid needless tinkering with parts that are working properly. Even should the cause of trouble not be apparent after a little reasoning, no attempt should be made to locate it by a general change of adjustments or tinkering done in a haphazard way, as this method will very frequently add to the trouble.

A definite system should always be followed.

Not only will this go far toward insuring success in locating the trouble, but it will, in nearly every case, save time; for unless the trouble is a very unusual one it will be located in one going over.

Practically all experienced operators, in hunting for the source of trouble with gas engines, follow, whether consciously or not, a more or less uniform system of tests. Just what order these tests should take will depend upon the particular make and type of engine; the tests which can be made most quickly and easily should, of course, be made first. From the points mentioned in the following pages it is believed that any operator who does not already employ such a system can readily devise one which will be best suited to his particular engine.

STARTING TROUBLES.

Always bear in mind that for a gas engine to run it is necessary to have a compressed mixture of vaporized fuel (generally gasoline or kerosene) and air in proper proportions, which is exploded by a hot spark while the mixture is under compression. The spark should occur slightly before full compression, except in starting, when it should occur just after full compression has been passed.

When an engine refuses to start, the trouble will, with a very few exceptions, be due to some interruption of the supply of the proper mixture of gas and air, or to a failure of the electrical system which furnishes the spark to fire the compressed mixture. It seldom happens that both systems are at fault at the same time, so the first thing to do is to find out whether one of these systems has ceased to work properly.

The ignition system, on the whole, is more often the cause of trouble than is the fuel system, and it is usually advisable to test this first unless, on account of the construction of the particular engine in question, it is easier to make tests for troubles with the mixture supply.

TESTING THE IGNITION SYSTEM.

With all engines using spark plugs it is comparatively easy to ascertain whether the ignition system is working properly. Simply remove a plug and ascertain that the porcelain or other insulating material on the inside of the plug is not coated with carbon and that the points are properly spaced. One thirty-second of an inch is about the right space for most systems where a dry battery is used. This is about equal to the thickness of a worn dime. A wider gap will often make starting difficult, especially when the spark is rather weak or where a high tension magneto is used. In the latter case the best results will often be obtained when the gap is not more than one-fortieth or even one-fiftieth of an inch. Then re-attach the wire and lay the plug so that the metal base touches the engine casting, while the end of the wire and the metal tip of the plug are at least half an inch from any metal part connected with the engine and in such a position that the points are visible while cranking the engine. Then turn the engine over a few times (at least as many times as there are cylinders) and note whether a spark jumps across the space between the points. It is not sufficient, however, merely to ascertain if there is a spark—it must be hot enough to fire the compressed charge in the cylinder. It is, of course, difficult to tell by merely looking at it whether the spark is hot enough or not, but if it is a heavy blue, or a bluish-white, or a "fat" yellow one looking like a small flame, it is probably all right. If very thin and greenish, or showing red, the chances are it is too weak to fire the charge. One may familiarize himself with the aspect of a good spark as follows:

While the motor is in satisfactory running condition loosen the nut on the top of one plug while the engine is stopped so it will be easy to remove the wire from the plug after the engine is started. Then start the engine and, by taking hold of the wire where it is covered with insulation, move the end of the wire very slowly away from the center of the plug and watch the spark jump, closely observing its color and thickness.

It is also well to note the distance the spark will jump, yet not advisable to force it to jump too great a gap, nor should the end of the wire be allowed to rest in a position where the spark can not jump to the plug or the engine while the engine is running, as this tends to break down the insulation of the coil. In the case of high-tension magnetos there is no danger in this respect as they are fitted with a safety spark gap which the spark will jump, if for any reason the circuit is broken elsewhere.

Knowledge of just how much of a spark one should obtain with each kind of ignition system is frequently of great value in locating trouble, and everyone who operates a gas engine should make the above-described tests while the engine is in good order. If one is not sufficiently familiar with the looks of a good spark to tell by mere observation whether it is hot enough, a rough test may be made as follows: Place a thin piece of dry carboard, such as an ordinary visiting card, or three or four thicknesses of dry newspaper, between the points of the plug while it is lying on the engine in the position first mentioned, then crank the engine. A good spark will jump through these, leaving a tiny hole. A spark which will not do this is too weak to jump the spark gap in the cylinder under compression.

If the engine is equipped with a make-and-break ignition system, in which an igniter block is used instead of a spark plug, it can be ascertained easily whether the entire system, with the exception of the igniter block, is in good shape by disconnecting the wire from the igniter block and snapping it across the corner of the engine casting or the end of the other wire leading from the coil. But even though this gives a good spark it does not necessarily mean that the spark is given in the cylinder when the engine is turned over. It may be that the points of the electrodes inside the cylinder do not touch each other when they should or are not making a good contact because carbon, oil, dirt, etc., have accumulated between these points. Therefore, if a good spark occurs when the wire is snapped across part of the engine, crank the engine until the movable electrode is released and allowed to fly back.

If one is not sure just when the points of the electrode should be touching, the engine may be cranked very slowly for two full revolutions while the end of the wire is repeatedly snapped across its connection on the electrode. If no spark can be obtained at any position of the electrode, it is evident that contact is not being made by the points inside the cylinder (This is in case the other wire is grounded directly to the engine.). Sometimes the other wire is fastened to a piece of metal insulated from the engine. but which touches part of the engine for an instant when the spark should occur in the cylinder. In this case, if a spark can be obtained by bringing the ends of the two wires into contact it should be determined whether the insulated piece is making contact with the engine properly.

If no spark is obtained at the plug or igniter block when tested as directed, it will, of course, be necessary to look over the electrical system in order to ascertain what is wrong. The electrical systems of various engines differ considerably and no definite instruction can be given for different makes, but some general points will be mentioned. First of all see that the switch is in starting position. Much time has been lost in thousands of cases by trying to start the engine with the switch off. When the engine is one with which the operator is familiar he will, of course. know the proper position of the switch for starting. In all cases where a battery of dry cells is used, the switch should be closed. Some engines, however, are started with a spark from a magneto, for which the switch is in starting position when open.

Next, look over all wire connections to see that they are tight and clean. If the engine starts on a battery of dry cells see that all connections between the cells are tight and that no short circuits are caused by the metallic portions of the cells touching each other, or by metal connection with the engine, or by tools lying on the cells. etc. The small knurled nuts on dry cells frequently loosen from vibration and thus interrupt the whole ignition system.

It is a good thing to keep an ammeter handy for use in testing the strength of the cells of a battery. In testing with an ammeter it is best to discard all cells that do not test over 12 amperes. A new cell should test between 20 and 30 amperes. If no ammeter is available, a crude test can be made by striking the end of a wire connected to one end cell of the battery against the first connection on the cell at the other end.

Do not keep the wire in contact with the cell for more than an instant.

Doing so will weaken the battery, but by snapping it quickly across the edge of the knurled nut a few times and noting the sparks, one can ascertain whether the battery is producing a good current. By making this test a few times with a battery which is in working condition, one can easily learn about how much of a spark should be expected. The sparks in this case will not be so intense as those produced at the spark plug by the coil, but when the wire is snapped across the milled side of the nut on the dry cell there should be a sputtering succession of tiny sparks.

Another crude test by which one can soon learn to tell whether a dry cell is in good working condition is to touch at the same time with the tongue both the carbon and zinc connections on the cell. By making a few experiments with dry cells of various strengths, one soon is able to tell whether the cell is generating sufficient current for ignition purposes. There is absolutely no danger and no discomfort. There will merely be a slight tingling sensation and a sort of acid taste which will vary according to the strength of the cell.

If the ignition system is one which utilizes the current from a magneto, and no spark can be obtained at the plug, though the wiring seems in good shape, the trouble may possibly be in the magneto. Present-day magnetos, however, are very reliable and not likely to give much trouble in this respect. In most cases where there is good evidence that the magneto is at fault, it should be taken to an expert for repairs. An inexperienced person should never attempt to take a magneto apart; this is a job for an expert, or at least a good mechanic who is equipped with detailed instructions for undertaking the work. There are only a few things which may be done safely by an inexperienced person to remedy a defective magneto, and these may be done without taking it apart.

Sometimes too much oil will cause trouble by accumulating on the contact points in the breaker box. It is usually easy to examine these points and see if they have oil on them; are rough or pitted, or not opening properly. If oily, rinse with a little gasoline and wipe dry. If rough or pitted, the points should be smoothed with a file made especially for this purpose. If such file is not available a small knife blade may be used to remove the tiny tips of metal which have formed on the points and to round off the burred corners. It pays, however, to keep a suitable file on hand for this work, for pitted points are not uncommon, and unless properly smoothed up are liable to get into bad shape again very quickly. A gauge is generally furnished by magneto manufacturers to determine the proper distance between the points in the open position. The means of adjusting this distance vary with different makes of magneto, but are usually apparent upon examination. The points should separate about one-fiftieth of an inch. An ordinary pin is about one thirty-second of an inch in diameter and a fairly close estimate may be made using this fact as a criterion, if no gauge is available.

There is one other thing which the inexperienced operator may do to the magneto, and that is to see that the commutator brush, which may be made of wire gauze or carbon, is clean. Sometimes dirt or oil will collect on this brush and interfere with the electric current. The location of this brush varies on different makes of magnetos, but it is always located where it can be removed and cleaned easily.

Aside from these two things, however, the ordinary operator should not tamper with the magneto. There are few other things which may go wrong with it. These can be remedied only by an expert with special tools, etc., and it is extremely easy to do it harm. Simply removing the magnets without placing "keepers" on them (iron or steel bars to connect the poles) will materially weaken them, yet this is something the inexperienced person frequently does.

It is important that a waterproof cover be provided for the magneto, especially in the case of engines used out of doors, such as gas tractors, in order to protect the magneto from moisture and dust, as either of these is likely to cause trouble sooner or later.

During the past few years many stationary gas engines have been equipped with low-tension oscillating magnetos. Some of these are mounted directly on the igniter block, and it is easy to test the spark by removing the block and tripping the oscillator with the means provided. In other cases it is necessary to remove the end of the wire attached to the igniter block and wipe it across a metal part of the engine, at the same time tripping the oscillator. It is necessary that the end of the wire leave the metal almost instantly after the oscillator is tripped, otherwise the spark will not occur. A little practice will make this test comparatively easy.

TESTING THE FUEL SYSTEM.

When an examination has shown that a good spark is being obtained at the right time, the next step is to see whether the engine is receiving the proper mixture of fuel and air. Many carburetors are made so that it is easy to remove the cover and see whether there is gasoline in the bowl, and where this is possible it is the easiest way to determine whether the fuel supply is all right up to that point. Other types of carburetor have tight covers, but are equipped with small petcocks, by opening which one can determine whether a supply of fuel is available.

If there is no fuel in the carburetor, either the tank is empty or there is some obstruction in the pipe line between the tank and the carburetor.

To see that the carburetor contains a liquid which looks like gasoline, however, is not enough, as water and gasoline look very much alike, and it is not at all uncommon for water to be present in the gasoline system. Neither does this water always enter the system when it is being filled, as is generally supposed. It is often the result of condensation of moisture on the sides of the gasoline tank, which runs down and settles at the lowest points in the system. This may be in the bottom of the carburetor, in the supply pipe, or in the strainer, or settling chamber. Where strainers or settling chambers are provided, these should be drained and cleaned frequently, especially in cold weather, when any water present may cause considerable trouble by freezing.

A petcock on the carburetor is a good means for removing any water which may have settled at the bottom of the bowl of the carburetor, and which, when present, will cause difficulty in starting. When making a test in this way, it is usually advisable to allow enough gasoline to run through to make sure that the carburetor has a full supply, as sometimes a partial stoppage of the pipe will allow a small amount of gasoline to get by into the carburetor, but not enough to allow the engine to start easily. Allowing a half cupful of fuel to run through it eliminates this possibility. It is easy to ascertain whether water is present in the carburetor by catching in a glass bottle or tumbler the liquid which runs through when the petcock is open. Any water present will settle at the bottom of the glass and a thin line will be visible between the water and the gasoline.

It is not enough merely to have fuel in the carburetor; it must be mixed with the proper amount of air as it is drawn into the combustion chamber. It sometimes happens that the needle valve is closed or stopped with dirt, and that while there is fuel in the carburetor none can get into the combustion chamber. If the engine has a petcock leading into the combustion chamber, by opening this and cranking the engine a few times one can tell by smelling the escaping air whether gasoline is entering the chamber. The same result can be obtained by smelling the exhaust when the engine is turned over, or by removing a spark plug, closing the hole during the suction stroke and opening it during the compression stroke.

By alternately opening and closing the needle valve, first being careful to note the original position so that it will be possible to readjust it if necessary, it is easy to see whether a different mixture will make the engine start. Or, when there is doubt whether enough fuel is entering the cylinder, a small quantity of gasoline (about a teaspoonful) may be poured into the combustion chamber through the priming cock or spark-plug hole and allowed to stand for a minute or two to vaporize and mix with the air before cranking the engine. If then one or two explosions occur and no more, it is an indication that only the priming has burned, and that fuel is not being furnished in sufficient quantity through the carburetor.

It sometimes happens that too rich a mixture of fuel and air enters the combustion chamber, which is practically as bad as no fuel at all, as the rich mixture can not be exploded by the spark. This does not often happen with a cold engine and with the grades of fuel now on the market, but it is not at all uncommon with a warm engine. There are several ways of overcoming this difficulty. Closing the needle valve and cranking the engine a few times will remove the rich mixture quickly and replace it with practically pure air. Removing a spark plug or opening a petcock leading into the combustion chamber and then cranking the engine slowly a few times, may answer the purpose, although as long as the needle valve is open some fuel will continue to be drawn into the cylinders.

TESTING THE COMPRESSION.

It seldom happens that the compression of an engine suddenly becomes so poor through ordinary wear as to make it impossible to start with the methods commonly used. An open valve, however, will bring about this result. Anyone who has ever started a gasoline engine when it was in good working order should be able to tell at once whether the compression is entirely gone as soon as he undertakes to crank the engine. When compression suddenly fails it is probable that the cause is one of those shown in the trouble chart on page 15, and the remedy is usually obvious when once the cause is located. The hiss made by the escaping air during the compression stroke is often enough to indicate the place where it is escaping.

STARTING IN COLD WEATHER.

It is important that engine operators familiarize themselves with the bad effects produced on gas engines by cold weather and with the easiest ways of overcoming them, for with such knowledge it is comparatively easy to start a gas engine in the severest weather.

The cold affects starting in three ways: (1) it makes it harder to crank the engine, because the oil congeals on the bearings and around the piston and valves, (2) where a dry battery is used it weakens the spark, (3) it causes gasoline to vaporize very slowly or not at all, therefore makes it difficult to obtain a mixture of gasoline vapor and air which can be ignited by the spark.

The congealing of the oil is not usually a very serious difficulty, although it may necessitate a great deal more effort in cranking the engine. A little gasoline or kerosene on all bearings which can be reached will help, and a liberal priming of gasoline in the cylinder will tend to thin the oil around the piston as well as aid in obtaining a good mixture, as noted below.

Do not use kerosene in the cylinder to make the engine crank easier.

It will interfere with the forming of a combustible mixture. Also where gasoline or kerosene has been used on bearings to make cranking easier, the engine should not be put under a load until the bearings have had time to get well lubricated again with good oil.

The effect of cold on the ignition system will be noticeable only where dry cells are used, with the exception that where the engine is equipped with a timer which is oiled, the congealing of the oil may interfere with the contact of the timer, in which case a little kerosene or gasoline may be necessary to thin the oil. When dry cells are cold they become less active, and at extremely low temperature they will cease giving a current. Therefore a dry battery should be kept in a warm place during the winter when not in use, so as to be active when needed. If this has not been done it should be set in a warm place for several minutes before attempting to start the motor in cold weather. Never warm a battery by applying intense heat directly to the cells, but allow them to warm slowly. While in operation they will generate sufficient heat to keep them active. With cells which have been sealed in paraffin or other wax, care should be exercised not to expose them to a temperature high enough to melt the wax.

The most serious effect of cold weather on gas engine operation is attributable to the fact that cold retards the vaporizing of the fuel. Gasoline as a liquid will not burn; it must first be turned into a vapor and this vapor mixed with a certain amount of air. A thin spray of gasoline in warm air will quickly turn to a vapor and mix with the surrounding air, but at low temperatures a considerable part of such a spray will remain a liquid, hence will not make an explosive mixture. The remedy is obvious. A greater quantity of gasoline must be furnished so as to give off more vapor in order to make a mixture rich enough to be combustible, or the air must be heated so the gasoline will vaporize more readily, or a combination of these expedients must be tried.

If the weather is only moderately cold, it is usually sufficient to prime the engine in some way, that is, inject a small quantity of gasoline (about a spoonful) into the cylinder, ordinarily either through a petcock or priming plug, in order that more fuel may be present, hence more vapor. Whenever an engine is primed, a short time should be allowed for the fuel to vaporize and mix with the air before attempting to crank the engine. If this is not done the vapor will pass out a little at a time through the exhaust valve as the engine is cranked, and the priming will not serve its purpose.

In very cold weather, however, priming with ordinary commercial gasoline will sometimes be insufficient, and heat must be applied by some means in order to produce vaporization of the fuel, unless a more volatile fuel is used for priming. A very satisfactory way to apply heat is to put some hot water into the cooling system, thus warming the cylinders and assisting in vaporizing the gasoline that is drawn in with the charge or injected as priming. In this case also, the engine should be allowed to stand a few minutes to permit the gasoline to vaporize. It is not necessary that the entire cooling system be filled with hot water; if enough is used to heat the cylinders so the engine will start, cold water may then be added until the radiator is full. This method, of course, will be practicable only with small or medium-sized engines; with some of the larger sizes of tractors the amount of hot water usually available will have little effect used in this way.

If only a little hot water is available, it may be more effective if poured slowly over the intake manifold, and the carburetor as well, if the carburetor is covered so no water can enter it. A very effective way of heating the intake manifold is to wrap a cloth around it and pour the hot water over the cloth, or dip the cloth in hot water and then wrap it around the manifold.

If the manifold can be heated it will warm the air that touches it as it enters the engine; this warm air will cause the gasoline spray which it carries to vaporize. As a greater proportion of the air passing through a small pipe comes in contact with the walls of the pipe than in the case of a large one, this method works best with engines having a comparatively small manifold. When depending upon heat from the manifold to warm the air the engine should be cranked fairly rapidly, so as not to allow the warmed mixture to remain long in contact with the cold walls of the combustion chamber and so cause the vapor to condense into liquid again.

There are frequently occasions when an engine must be started in cold weather under conditions where hot water can not be obtained, and in such cases some other means of applying heat must be used. Some people make use of a blowtorch to apply the heat to the intake manifold, or, by removing a spark plug or igniter block, heat the combustion chamber itself.

The use of an open flame around a gas engine at ordinary temperatures is not to be recommended, on account of the possibility of fire. It always introduces an element of danger.

One of the most effective methods of starting a cold engine, and one absolutely safe, is to remove the spark plug (or igniter block) and heat it in a fire or in the flame of a blowtorch, prime the engine, and then quickly replace the spark plug. The charge is almost sure to ignite. A drop or two of gasoline put on the inside of the plug just before replacing it insures the presence of vaporized fuel near the spark when the engine is cranked.

Where, for any reason, it is impracticable or inadvisable to apply heat in any of the ways indicated it may be possible to heat a piece of metal pipe the size of the air intake of the carbureter then place this so all the air entering the carbureter must pass through it. This is nearly as effective as a heated manifold. Such a pipe may be made red-hot if desired.

Another means of starting engines in cold weather, which is practiced to a considerable extent, is to provide some very volatile fuel with which to prime it, ether or "high-test" gasoline being perhaps most commonly used. As these will vaporize at lower temperatures than ordinary commercial gasoline, they make it easier to obtain a combustible mixture. In using ether, care must be exercised not to use too much, as dangerous pressures may be created because of the rapidity with which it burns. In many cases it is used mixed with about equal parts of gasoline. There is no danger in the use of the high-test gasoline. It is not quite so effective as ether, because it is less volatile, but it is being used with entire satisfaction by a great many engine owners.

IMPORTANCE OF THOROUGH KNOWLEDGE OF GAS ENGINE.

Because of the economic value of the gas engine for many kinds of farm work, and the fact that this machine seems destined to be used more and more for such purposes, it is highly desirable that at least one person on every farm where a gas engine is employed should understand fully the principles of its operation. The importance of this point can not be overemphasized. Excellent opportunities are offered to enable anyone to obtain an education of this kind. The various State colleges usually have short courses in gas engine operation. These are conducted by thoroughly competent men, experienced in teaching, and usually with first-class facilities and equipment for this work. These courses are already popular, but it is believed that if their value was more fully appreciated by farmers the attendance would be very much greater. Numerous private schools also specialize in this line.

For those persons who can not avail themselves of these opportunities, there are excellent books on the subject, and various publications with a large farm circulation carry " home courses " designed to reach these very people. A course of instruction under a capable instructor, with working models, is much to be preferred, of course, but if it is impossible to take such a course, it is highly advisable to spend a little spare time in studying the subject from books.

TROUBLE CHART.

There are nearly always several different things which might produce any one of the various troubles common in gas engine operation, and, as already pointed out, unless the operator takes time to reason the matter out, he is very apt to jump to a conclusion which is quite likely to be a wrong one. The exact cause of a trouble will frequently not be apparent at once even to the most experienced operator, and the use of the accompanying chart showing the possible causes of the various irregularities will often save considerable time by acting as a reminder of such causes. With these in mind, a little reasoning, and perhaps a few tests, nearly always enable one to reach the correct conclusion.

TROUBLE CHART FOR GASOLINE ENGINES.

Loss of power:

Ignition: Spark occurring too late; spark weak because of partial short circuit or battery becoming exhausted; dirty spark plugs; poor connections; dirty timer; poor or broken wiring in case of magneto; breaker points worn, oily, or out of adjustment; commutator brush dirty or oily.

Fuel: Mixture too lean or too rich; supply pipe partly clogged; inlet valve not opening sufficiently due to wear; water in gasoline; leaks around intake manifold.

Motor: Overheating in cylinder or bearings; gummy, inferior or insufficient oil; exhaust pipe partially clogged; governor out of adjustment; lack of compression, which may be due to worn, stuck, or broken piston rings; scored cylinder walls; leaks through and around head joints; valves sticking, worn, pitted, or not seating properly because of dirt; in cold weather engine and cooling water too cold.

Misfiring:

Ignition: Weak batteries; poor connections; dirty timer; vibrator points pitted or dirty; dirty or cracked plugs, points of plug not properly spaced; make and break points not touching properly.

Fuel: Mixture too lean or too rich; gasoline passage partly clogged; water in gasoline.

Motor: Lack of compression; valves sticky or not working properly.

Pounding:

Ignition: Spark too early.

Motor: Red-hot carbon deposit in cylinder; loose bearings; tight piston, due to lack of oil or lack of cooling water; hot bearings; loose flywheel; very loose piston (piston slap).

Backfiring:

Ignition: Spark too late. (If motor backfires and stops, spark may be too far advanced); short circuit on primary wire; wires to wrong plugs.

Fuel: Weak mixture; occasionally too rich mixture.

Motor: Leaky or stuck intake valve; red-hot carbon deposits; leaky manifold or carburetor gasket.

Explosions in exhaust pipe[a]:

Ignition: Irregular ignition; poor spark, or very late spark.

Fuel: Mixture too lean or too rich.

Overheating:

Ignition: Spark too late, or very weak.

Fuel: Mixture too rich.

Motor: Insufficient lubrication; insufficient cooling water; circulation of cooling water impeded; pump not working properly; heavy carbon deposits in cylinder; water chamber coated from impure water.

Irregular speed:

Ignition: Loose connections, or partly broken wire; vibrator points rough, pitted, or improperly adjusted.

Fuel: Supply to carburetor irregular; dirt on needle valve.

Motor: Governor gummy, sticky, out of adjustment or badly worn; valves sticky.

Smoke:

Black smoke in exhaust indicates too rich a mixture. Bluish smoke indicates too much lubricating oil. Smoke from the crank case or open end of cylinder indicates leak past the piston; look for worn rings, rings stuck in grooves, or scoring on cylinder walls.

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[a] Often occurs just after starting due to first charges not firing in cylinder and passing through into exhaust pipe, where burning gases from first few explosions will ignite them.

WINTERING BEES IN CELLARS

E. F. PHILLIPS, Apiculturist
and
GEORGE S. DEMUTH, Apicultural Assistant
Bureau of Entomology

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L. O. HOWARD, Chief

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RESULTS from wintering bees in a cellar are excellent when conditions in the cellar are such as to keep the bees from wearing themselves out by excessive activity. Cellar wintering is practicable where the average outdoor temperature during the winter months is as low as 25° F. A map is given (p. 3) so that the beekeeper may know whether this method is advisable in his locality.

The cellar should be arranged so that the ceiling is below the frost line, and so that the ceiling and side walls are thoroughly protected at all points. The cellar should be kept so that the lowest temperature within the hives is at least 52° F. At this temperature there will be little need of special ventilating arrangements. There should be no condensation of moisture within the hives, and the cellar should be well drained.

Bees should be put into the cellar after a good flight in late November, or earlier in the more northern localities. They should be removed when fresh pollen and nectar are available, usually about the last of March.

Soon after the hives are placed on their summer stands, each colony should be given additional stores and room for the development of a large quantity of brood.

It is important that none of the factors of good wintering be omitted. Several tests are given in this bulletin so that the beekeeper may determine whether his cellar is a satisfactory place for wintering bees.

WINTERING BEES IN CELLARS.

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CELLAR WINTERING VERSUS OUTDOOR WINTERING.

BEES in the more northern parts of the United States for many years have been placed by some of the best beekeepers in cellars or special repositories during the coldest parts of the winter. There has been a growing feeling, however, that if outdoor wintering is practicable, in most cases it gives better results, and there has been a decided change from cellar wintering to outdoor wintering within the past decade. The difficulty seems to be that the methods of cellar wintering practiced have not been satisfactory and it seems probable that if as much attention had been given to the perfection of the methods of cellar wintering as has been given to an improvement of the methods of outdoor wintering, there would not have been as great a change to the outdoor methods as has taken place.

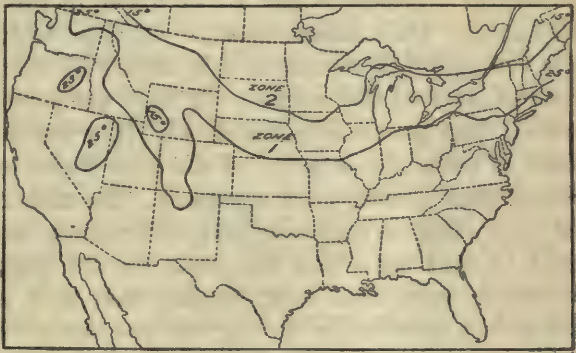

FIG. 1.—Map of the United States showing regions where cellar wintering is practicable, based on the average temperature of January. From data furnished by the United States Weather Bureau.

The placing of bees in a cellar is only another way of putting insulation about the hives, the only difference being that in the cellar all of the hives are protected alike and the protection is placed about the apiary instead of around hives in groups or singly. It follows that the principles which apply to successful outdoor wintering apply equally to the protection of the bees in the cellar. It is urged, therefore, that before attempting to winter bees in the cellar, the beekeeper study the bulletins[1] of the department in which these principles are set forth.

WHERE IS CELLAR WINTERING ADVISABLE?

Before deciding whether or not the bees are to be wintered in a cellar, several factors should be considered, the chief of these being (1) the winter climate, (2) the kind of winter stores, and (3) the location of the apiary as regards wind protection.

WINTER CLIMATE.

In any locality where the average temperature of the winter months falls below 25° F. (zone 1) cellar wintering may be practiced with profit, and in localities where the average temperature of these months falls as low as 15° F. (zone 2) cellar wintering is much to be preferred. Figure 1 shows the boundaries of these zones for the United States for the month of January, which may be taken as typical of the winter months. It will be noted that these zones do not follow parallels of latitude. As was pointed out in the bulletin of the department on outdoor wintering,[2] it is quite possible to protect bees in zone 1 sufficiently to winter them outdoors, but if a proper cellar is provided, if conditions within the cellar are correct, and if the stores are good and the colonies are strong, just as good results may be obtained from cellar wintering.

In zone 1 the average temperature of the outside air during the month of January is 25° F., or lower in the more northern parts of the zone. This means that in colonies wintered outdoors the bees are compelled to overcome this degree of cold at all times during the coldest part of the winter. If they are so well packed that the heat which they generate is lost slowly, they are able to generate sufficient heat to make the interior of the hive warm enough to allow them to break their cluster as is necessary. In zone 2, however, the bees will be compelled to generate heat sufficient to overcome the more severe cold of that zone, and this calls for the expenditure by the bees of so much more food and vitality that it is more economical to put them in a good cellar during the months of the most severe cold, and cellar wintering is therefore preferable.

CHARACTER OF WINTER STORES.

In localities where the stores for the bees gathered during the latter part of the summer are not of the first quality, it is safer to winter the bees outdoors. This is a large factor in the placing of the zones shown in figure 1, for it is quite common in the region south of zone 1 for the fall honey to be of inferior quality. It is extremely fortunate that in both of the zones shown the stores available in winter are usually of the finest quality. As will be shown later, it is highly important that the beekeeper pay special attention to the character of the stores in the hive at the beginning of the winter, and if they are not as good as they should be, this deficiency should be corrected.

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[1] Department Bulletin 93, The Temperature of the Honeybee Cluster in Winter. Farmers' Bulletin 695, Outdoor Wintering of Bees.

[2] Farmers' Bulletin 1012, Preparation of Bees for Outdoor Wintering.

LOCATION AS REGARDS WIND PROTECTION.

In zone 1, if the apiary is so badly located that the winter winds are severe, the beekeeper will do well to winter in a cellar, although, as will be shown later, it is not best to choose such a site for the apiary even during the rest of the year.

ESSENTIALS TO SUCCESS.

As in the case of outdoor wintering, the essentials to success in caring for a normal colony of bees from the end of one season's honey-flow to the beginning of the next lie in providing three things in abundance: (1) Stores of good quality, (2) protection from wind and cold, and (3) room for the rearing of brood at appropriate times. These factors must not be lacking at the right times, and if any one is omitted it may prevent the bees from gathering the crop of the following season. These three factors do not apply equally throughout the period of relative inactivity, but as certainly as any one of them is decreased, just so certainly will the crop of the following year be reduced.

In practicing cellar wintering it is unnecessary to leave so much honey with the bees during the time that they are in the cellar, and it is not necessary during that period to leave room for the rearing of brood. During the coldest part of the winter the bees need especially protection from cold and wind, although enough good stores must be in the hive to keep them through that period in good condition. Probably a large part of the failure of beekeepers in practicing cellar wintering comes from the fact that before and after the bees are in the cellar the important factors of stores and breeding room have not been adequately supplied. Before the bees are put into the cellar they must have room for breeding and stores in abundance, and after they are taken out these two factors must be present in greatly increased abundance.

NECESSITY OF STRONG COLONIES IN THE FALL.

As in the case of wintering outdoors, it is wasteful to attempt to winter weak colonies. It is difficult to set standards of colony strength at this season, but it is unwise to attempt to winter colonies that are not strong enough to have brood sufficient to fill three or four Langstroth frames two months before the first killing frost. If the colonies in the apiary are not of the proper strength, it is wise to unite until the proper strength is reached. Any uniting should be done before the close of brood-rearing.

It is of the greatest importance that every colony have a good queen in order that brood-rearing may continue in the fall and may then again proceed rapidly in the spring. Usually it is best to requeen at least every two years, but if good wintering is practiced the colonies will come out of winter quarters so strong and will build up so rapidly in the spring that the queens will soon wear out, making it safer to requeen every year. To get the best results from requeening, all young queens should be introduced so that they begin to lay about two months before the first killing frost.

WINTER STORES.

The stores given to the bees from the end of one season to the beginning of the next are of the first importance. It is necessary to consider both the quality and the quantity of these stores.

QUALITY OF STORES.

As has been stated, it is fortunate that in both of the zones where cellar wintering is or might be practiced the natural stores usually are good. Honeys such as those from white and alsike clovers, sweet clover, alfalfa, wild raspberry, buckwheat, and willowherb are fine stores for winter, while honeys from basswood, heartsease (smartweed), asters, goldenrod, and most of the other fall flowers are less desirable. It is especially important during the period when the bees are in the cellar that the stores shall be of the very finest quality, and it is therefore the practice of many good beekeepers to feed each colony 5 pounds or more of sirup made of granulated sugar late in the fall, after all brood-rearing has ceased. This insures that the bees will have for their use, during the period of confinement in the cellar, stores which will not bring about the condition known as dysentery. In general it may be stated that honeys from mixed sources and dark honeys, except buckwheat, are to be avoided. Honeydew honeys are highly injurious and in all cases where such stores are present granulated sugar sirup should be fed.

QUANTITY OF STORES.

From the end of one honey season to the beginning of the next a good colony of bees will need fully 45 pounds of honey. When the bees are wintered in the cellar, it is usual not to have all of this honey in the one hive body in which they are wintered. It is a good practice to have at least 20 pounds within this hive, although 15 pounds will be safe. It is absolutely imperative, however, that the remainder of the 45 pounds shall be available to be given to the bees soon after they are taken from the cellar. The most common cause of poor colonies in the spring is poverty, directly due to neglect on the part of the beekeeper. A good beekeeper sees to it that at no time when brood is being reared do his bees have less than 15 pounds of stores in the hive, and the full amount of 45 pounds often will all be used, and is always needed if the colonies are to come to full strength on time for the gathering of the full crop. This amount is always augmented by honey from spring flowers, for 45 pounds of honey is not enough to bring a colony to full strength in time for the main honeyflow.

ARRANGEMENT OF THE APIARY.

Where bees are wintered in cellars the particular arrangement of the hives in the apiary is not so important a problem as where they are wintered on their summer stands, yet there are certain important considerations in the arrangement of the entire apiary which should be kept in mind.

WIND PROTECTION.

It is important that a place be chosen where the bees will be protected from cold winds in the spring after they are taken from the cellar and again in the fall before they are taken to the cellar. A grove of trees or an adjacent hill usually offers the best protection, or it is possible to make an artificial windbreak such as a high fence. A natural windbreak usually is better, for it is more extensive in most cases. Too much reliance should not be placed in buildings, for often they merely divert the wind slightly and may make conditions worse. A fence made of close boards usually is unsatisfactory, for it causes whirls.

DISTANCE OF THE APIARY FROM THE CELLAR.

To carry colonies of bees a long distance from the apiary to the cellar is not an easy task, even though the hives be light at that time of the year. It is best, therefore, that the apiary be located not more than 50 yards from the cellar, and even this distance is objectionable. If a special cellar is built for the bees, the apiary should be so located that the cellar may be built immediately adjacent. If the bees are to be wintered in the cellar under the beekeeper's residence, the apiary should be located as near as possible to the cellar door.

THE BEE CELLAR.

In order that the beekeeper may have reason to expect success in cellar wintering, it is imperative that he give careful consideration to the construction of the bee cellar. There has been a tendency among beekeepers greatly to overestimate the value of their own cellars, and especially to assume that the conditions which they are able to get in their cellars are exactly correct.

CELLAR UNDER THE RESIDENCE.

Some of the best bee cellars are those under the residences of beekeepers, and in general such a cellar is better than one built especially for cellar wintering. This is because the temperature of such a cellar usually is quite a little higher than that in a specially constructed repository. The best results in cellar wintering have been obtained in cellars under residences which are heated by furnaces, thus having a higher cellar temperature. In such a cellar provision must be made for partitioning off a space where the bees will be located so that there is no light or other disturbing factor during the time of their confinement. Since a cellar temperature about 50° F. is desirable, it is well to choose a part of the cellar through which some of the furnace pipes run, and if this results in too high a temperature these pipes may be insulated somewhat. It is best to choose a part of the cellar where there are no windows and where the outside walls are thoroughly protected to the top, either by a bank of soil or in some other fashion. This will result in a more equable temperature than is possible in a cellar exposed to sudden changes of temperature on the outside walls, for even a stone wall 18 inches thick will allow a considerable amount of heat to escape. In a cellar under a residence there will be abundant ventilation without any special provision being made for this. A test of the value of such a cellar is the even temperature which may be obtained, as will be discussed later.

SPECIAL WINTER REPOSITORY.

If properly constructed and protected, a special cellar or cave for the bees gives the best possible results in wintering, yet few such cellars have been built, for the reason that most beekeepers have omitted some vitally important factors. The usual fault is in having too great a variation in temperature and in giving excessive ventilation, which in turn causes fluctuations in temperature.

SOIL AND CONTOUR OF THE SURFACE OF THE GROUND.

To provide good drainage and adequate ventilation for the bee cellar without making any special ventilators, it is desirable to build it in a sandy hillside. If it is possible to choose a place for the cellar where the snow drifts deeply, this will afford a valuable addition to the insulation of the cellar. If the cellar is on level ground, drifting of snow may be increased by the proper building of open fences, such as are used to prevent drifting over railway tracks.

If it is impossible to utilize a sandy hillside, it will be necessary to build walls and a floor for the cellar and to make adequate provision for the drainage of the cellar. The hillside cellar has the great advantage of having easy drainage.

CAPACITY OF THE CELLAR.

If the bees are kept in apiaries of perhaps 100 colonies and if a cellar is built for each apiary, then it is possible to build a cellar of just the right capacity. If a central cellar is built for all the apiaries and the bees in outapiaries are brought into the home apiary for winter, the beekeeper will wish to build the cellar sufficiently large for future expansion of his business, and beekeepers are finding out that they can keep many more colonies of bees than they formerly thought possible. Perhaps the better plan is to have a cellar in each apiary.

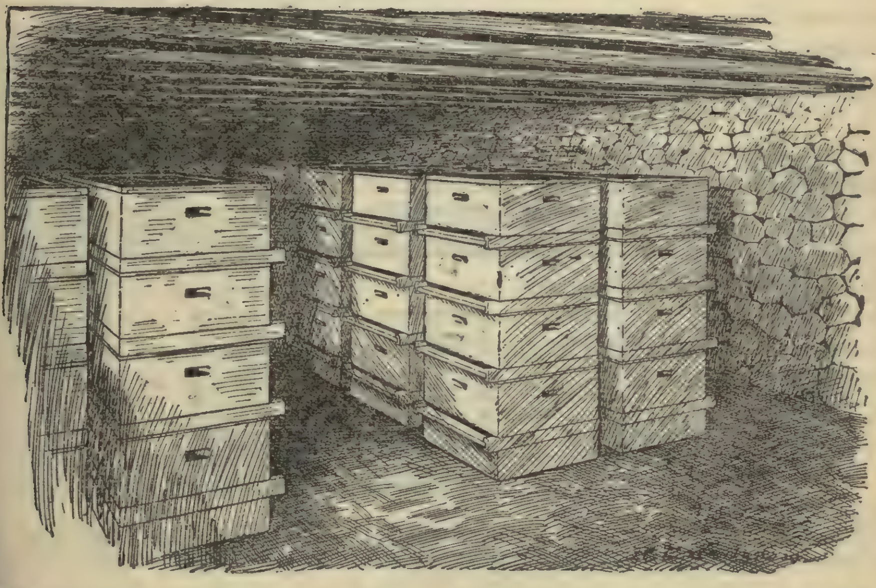

FIG. 2.—Interior of bee cellar with hives in piles of four. Insulation above the ceiling is not shown.

The usual practice is to allow 1½ to 2 square feet of floor surface for each colony, on the assumption that the colonies will be placed in piles of four (fig. 2). It is not desirable to pile hives higher than this, if the cellar roof is 6½ feet high in the clear, and it is difficult to lift heavy hives any higher than the number specified. For an apiary of 100 colonies, it will be found desirable to have a cellar 10 feet wide and from 15 to 20 feet long, clear of the inner walls. If one is just getting a start in beekeeping he should build his cellar on the assumption that later he will increase the number of his colonies, and should allow for this, for it is better to have the cellar too large than too small.

WALLS AND FLOOR.

It has been claimed by many beekeepers that concrete walls and floor are not desirable, yet if the cellar is properly insulated there is no better material. If the cellar is built in a hillside of sandy soil, wooden sides will be satisfactory and no floor other than the soil need be provided. In such soil the drainage is good and the only function of the side walls is to hold the sides up to prevent caving in. In a moist soil a concrete floor and walls should be built, and the concrete should be waterproof. Under no circumstances should any of the side walls below the ceiling be exposed above ground.

ROOF.

The ceiling of the cellar should be below ground level sufficiently to bring it below the level of frost. For the regions where bees should be wintered in cellars this usually will be at least 2½ feet below the level of the ground (fig. 3). The ceiling should be 6½ feet above the floor, just sufficiently high to permit a tall man to work with comfort. If the ceiling is higher it will result usually in too low a temperature at the floor. The ceiling then should be covered completely on top with some insulating material, such as sawdust, and if sawdust is used it should be piled on about 1½ feet thick. Unless about this amount of protection is given on the ceiling it will be impossible to get the right cellar temperature during the coldest part of the winter. If the cellar is built in a sandy soil, it is possible to use the soil as a cover for the ceiling, in which event about 3 feet of soil should be placed over the inner roof of the cellar. The entire insulating material, of whatever kind used, should then be protected from rain and snow by having a roof over it. This roof should project at least 2

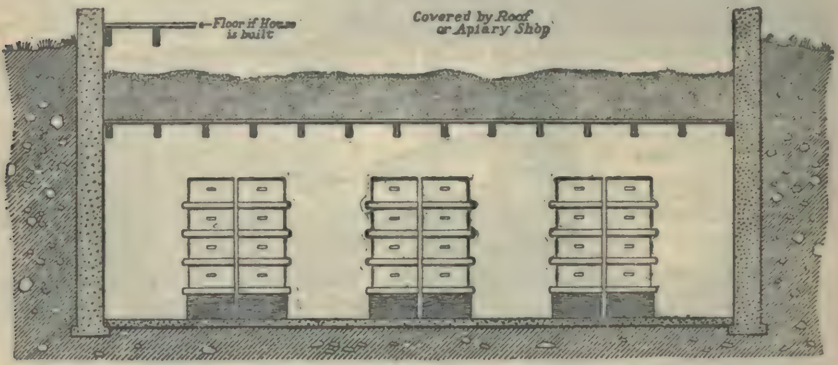

FIG. 3.—Diagram of bee cellar. Clearance 6½ feet, ceiling 2½ feet below ground level, packed with about 1½ feet of sawdust.

feet, preferably more, beyond the outside of the cellar wall, and provision should be made for carrying off the water from the roof.

In case the beekeeper desires to build an apiary house over the bee cellar, as is done frequently, he must provide a floor for this house at least at ground level, and he can not successfully use the ceiling of the cellar as the floor of the upper house. There is no objection to building a house above the cellar if adequate protection is given the cellar, but it must not be assumed that the house offers any material insulation to the cellar, for in most cases these houses are not heated in the winter. The relation of the house floor to the ceiling of the cellar is shown in figure 3.

ENTRANCE TO THE CELLAR.

Frequently the entrance is a weak spot in the insulation of the cellar, and it is useless to protect the roof and sides unless care is used in the building of the entrance. If the entrance is at the end or one side of the cellar, it will be necessary to build a sort of vestibule with double doors so that the heat of the cellar will not be lost rapidly. The heavier and thicker these doors, the better for the bees.

The best type of vestibule is a long, narrow passage leading into the hillside, and it should be closed by doors at both the inside and outside ends. If possible the vestibule should be built and protected so that the temperature within the vestibule will never fall below freezing. In the building of the vestibule, also, the beekeeper should consider the ease with which the bees may be carried in and out of the cellar.

DRAINAGE.

As has been mentioned previously, the cellar must be well drained, either by natural or by artificial means. No stagnant water should be allowed to remain in the cellar, although at the higher temperatures of the best cellars this does less harm than it does in cellars that are too cold. Some beekeepers have advocated having a stream of water flowing through the cellar, and this will do no harm in warm cellars, and it may serve to assist somewhat in maintaining an even tempertaure.

VENTILATORS.

One of the most serious faults of bee cellars is in providing for too much ventilation, resulting in great fluctuations in temperature. In a cellar which maintains a temperature of 50° F. or more there is little need for ventilation, for the bees then need little oxygen and only a small amount of carbon dioxide is given off. Other things being equal, the colder the cellar, the greater the need of ventilation. If poor stores are in the hives, the bees will need more ventilation than will be desirable when good stores are used. In a warm cellar in a sandy hillside no ventilating shaft need be built.

In any event, one shaft 6 inches square running through the ceiling of the cellar to the outside will be sufficient for any cellar that is fit for the wintering of bees. During the coldest part of the winter the interchange of air between the inside of the cellar and the outside will be materially increased by the great difference in temperature and this one ventilator may be entirely or nearly closed. During the milder weather of the fall and spring this amount of ventilation will do no harm. The top of the ventilating shaft, which should extend at least 6 feet above the outer roof, may be painted black in order to induce greater movement of air when the sun shines. The shaft should be so arranged that it does not admit light to the cellar.

PUTTING THE BEES INTO THE CELLAR.

Before the bees are carried into the cellar it should be well aired and cleaned, and it will be well to keep it open for several days beforehand. No débris or refuse should be left in the cellar when the bees are taken in.

TIME.

For zone 1 (fig. 1) it is usually desirable to wait until about the middle of November before putting the bees into winter quarters. If one could know exactly when the bees would have the last opportunity for a cleansing flight, they would be put into the cellar just after that, but we can not always be sure that there will be suitable weather for such flight in late November, and there is, therefore, considerable doubt every year as to just the right time to put the bees away. Frequently it happens that the weather is suitable for a flight about November 20, and it is best to wait until then before attempting to put the bees in the cellar. The flight of only a few bees from the hive should not be construed as a cleansing flight. In this connection it is highly desirable that the beekeeper keep a careful watch of the weather maps daily, so that he may know at all times about what weather may be expected for a few days in advance. For the beekeeper's purpose the daily forecasts published in newspapers are scarcely enough; and if no daily weather maps are convenient near by, it will repay the beekeeper well to subscribe for them. They are valuable not only at the time of putting the bees into the cellar but at many other times of the year.

Soon after a period when the barometric pressure has been low, bringing high temperatures suitable for flights (at least 60° F.), there usually will be a period when the barometric pressure is high, bringing lower temperatures. At the shifting from low to high barometric pressure there is frequently a time when it is cloudy.

This is a fine time to put the bees into the cellar. These periods of high and low barometric pressure follow each other with rather marked regularity in the fall, and it is rather safe to assume that just at the end of the well-defined low pressure which next follows after November 15 is the best time to put the bees into the cellar. It is better to put the bees in the cellar a week or so before the last opportunity for flight than to put them in after exposure to cold which is not followed by a cleansing flight.

For zone 2 it will be desirable to put the bees away a little earlier, although the oncoming of winter is not so much earlier in the North as one might imagine.

HOW TO CARRY THE BEES.

When one person carries the bees into the cellar the best method is to stand at the back of the hive and grasp the bottom of the hive with both hands. The hive is then lifted and the cover brought up against the chest firmly, permitting the operator to walk without interference and with a minimum of stooping. If there are cleats on the ends of the hive bodies, these may be rested on the forearms, although with this method there is some danger that the bottoms will drop off unless they are stapled.

If the temperature is sufficiently low (slightly above freezing), there will be no need of closing the entrances when the bees are being carried in. Every care should be taken not to jar the hives more than is absolutely necessary from the time that they are lifted until they are in their final place in the cellar.

If more than one person is engaged in carrying in the hives, the hives may be placed carefully on carriers with handles, and two or more of them may be carried at one time.

HOW TO STACK THE HIVES.

The bottom hive in a pile should rest on an empty hive body or some other such support of about that size (figs. 2 and 3). The hives then should be placed one on top of the other until they are four high. It is best by far to put each pile of four hives about 6 inches from adjacent piles, so that in handling the hives on one pile there is no disturbance of bees in other piles. Allowance is made for this space between the piles of hives in the estimate of the floor space needed for each colony (p. 9).

MAINTENANCE OF THE CELLAR DURING THE WINTER.

If the cellar is properly constructed it will need little if any care during the time that the bees are inside. It is only the poor bee cellar which requires constant attention to prevent changes in temperature.

TEMPERATURE OF THE CELLAR.

There has been much discussion as to the best temperature of the cellar during the winter. Commonly it is stated that a temperature of 40° to 45° F. is best, but this is colder than usually is best for the finest results. A temperature below 40° F. is invariably bad for the bees, and a cellar in which the temperature goes as low as freezing is not a fit place for bees.

It has been found by the authors that bees do the least amount of work when the temperature of the air immediately surrounding them (inside the hive) stands at 57° F. This is, therefore, the temperature which the beekeeper should bear in mind, rather than to lay too much stress on the temperature of the cellar itself. The place for a thermometer in the bee cellar is inside the entrance of a good colony where it may be read easily by simply pulling it out. A chemical thermometer is best for this purpose, and it should register 52° F. or more inside the hive entrance. In order to have the right temperature within the hive it usually will be best to have the temperature of the cellar at about 50° F. or slightly higher. As will be shown later, however, it is quite possible to have the right temperature within the hive when the temperature of the cellar is a few degrees lower than that stated.

If the beekeeper will pay attention to the temperature of the interior of the hive he will find that in colder cellars it is desirable to give the hives some insulation to conserve the heat generated by the bees in much the same way that this heat is conserved when bees are packed outdoors, although the amount of protection will be much less. In a cellar where the temperature falls to 45° F. it will be found best to have the covers of the hives sealed on tightly and the entrances reduced to ⅜ inch by 2 inches. In a cellar with a temperature of 50° F. or more the entrances may be left open the full width of the hive. If there is a tendency for the temperature to fall to 45° F. or less, the tops of the hives may be protected by cushions of chaff or other materials placed at least on the top of the uppermost hives, for each of the lower three hives is protected somewhat by the one above it.

It will be impossible to maintain the temperatures recommended unless the cellar is built in the way described, or in some other way by which the cellar is equally well insulated. It is impossible to maintain an equable and high temperature in a cellar the walls and ceiling of which are exposed to the outside air.

VENTILATION OF THE CELLAR.

If the proper temperature is maintained in the cellar there will be little need of ventilation, for in almost all cases there will be sufficient interchange of air to keep the bees in good condition.

If the temperature is as low as 45° F., a little ventilation will be needed, although most of the bee cellars that have been built have had too much ventilation, and as a result it has been impossible to maintain a correct temperature within them. In cold weather the tendency toward an interchange of air is greatest, and at such times the ventilators may be entirely closed. In mild weather it makes no difference if large ventilators are open, unless this results in too great a rise in temperature.

In a well-insulated cellar it should not be necessary to ventilate at night at the approach of spring to cool the air inside, for the bees will not get so warm from their own activity as will bees in a cellar that is or has been too cold. The greatest problem in most cellars is to maintain the right temperature during the spring just before the bees are to be removed. The trouble is that in most cellars—those which are too cold in winter—the bees generate heat constantly during the winter and as a result have an accumulation of feces in the intestines, resulting in a condition known as dysentery. For this reason they become excited easily, and beekeepers have thought it necessary to ventilate the cellar at night freely in order to remedy this trouble. The proper method, of course, is to prevent it by keeping the temperature higher during the winter, but if the temperature has fallen too low during the winter ventilation at night seems to help somewhat. It is safe, however, to say that a cellar in which this happens is not satisfactory as a place to keep bees during the winter, and steps should be taken to insulate it more completely before bees are put into it again. If the bees are wintering on stores that are not of the best quality the tendency to accumulate feces will be far greater, even with the right temperatures inside the hives, and if there is dysentery it may be relieved somewhat by ventilation, although this is simply reducing a symptom and is not removing the cause of the trouble.

VENTILATION OF THE HIVE.

Since bees in a good cellar require little ventilation, practically no attention need be paid to this subject if the cellar has been built in the way advised. If the temperature of the cellar tends to fall too low, it is advisable to reduce the entrances of the hives, for with a greater difference between the temperatures within and outside the hive the tendency for interchange of air will be correspondingly greater. In any cellar fit for the wintering of bees it will be neither necessary nor desirable to ventilate the hives at the top, as sometimes has been recommended.

The ventilation of the hive within the cellar is not so much for the elimination of foul air as for the escape of moisture, and therefore the amount of ventilation needed for the hive depends upon the humidity of the air within the cellar. If the temperature of the cellar is kept high enough there will be no condensation of moisture within the hive, and if water is ever observed on the covers of the hives it is conclusive proof that the cellar is too cold for the bees. In a cellar so cold that condensed moisture shows on the bottoms of the hives steps should be taken at once to raise the temperature.

Various attempts have been made in the past to provide for the cellar fresh air which has been warmed somewhat before entry. The most common method is to have the air pass through tiles under ground for perhaps 100 feet before it enters the cellar. In general, it may be said that none of these devices has been worth the trouble and expense involved and none of them has served the purpose for which it was intended. It has been proposed also to ventilate the bee cellar by wind pressure. The devices which have been made for such ventilation will function only when there is considerable wind and then only when the wind is in the right quarter; therefore they are not at all to be recommended. By far the best plan is simply to build the bee cellar correctly, for then little ventilation will be needed.

CLEANING THE CELLAR.

In even the best of cellars there will be some dead bees on the floor, and these may be cleaned up once or twice during the winter. In a cellar with proper temperature there will be few dead bees until after the middle of the winter, but the death rate increases toward the close of the winter. If the cellar is cleaned, it should be done with as little disturbance as possible. No bright light should be admitted at this time, although a moderate amount seems to do little harm until after the bees have an accumulation of feces in the intestines.

REMOVING THE BEES FOR FLIGHT DURING THE WINTER.

Some beekeepers have advocated removing the colonies toward the end of the winter for a flight on some warm day and then replacing them, on the supposition that the flight would enable the bees to stand a longer period of confinement. It is found, however, that if bees are disturbed, as by carrying them out, they begin brood-rearing almost invariably, and this does more harm than the flight does good.

DISTURBANCE DURING THE WINTER.

Work in or about the bee cellar while the bees are confined should be done with the least possible disturbance of the bees, for often a little handling or jarring of the hive causes sufficient excitement to increase the temperature of the cluster to the point where brood-rearing begins. This is true especially in late winter. It is by far the wisest plan, therefore, to stay out of the cellar during the winter, except on the few occasions when a little work, such as cleaning out, makes a visit seem needed. Care should be taken not to jar the hives or to allow light to strike the entrance. Of course, if bees are being wintered in a cellar which has the right temperature, a little disturbance does little or no harm, but there is no reason why bees should be disturbed in winter and the beekeeper should not run any risk of starting brood-rearing.

REMOVAL OF THE BEES FROM THE CELLAR.

TIME.

The old rule of many beekeepers is to take the bees from the cellar when the soft maples are in bloom. This is an excellent rule in localities where there are trees of this species. In general, in zone 1 the right time to take the bees out of the cellar is about the time of the spring equinox (March 21).

In choosing a time for the removal of the bees, the beekeeper again should watch the weather maps closely. He should choose a time when a high-pressure area is just passing and at the approach of a well-defined low-pressure area. At such a time the weather will be cool, not permitting the bees to fly, but at the time of the low-pressure area the weather will become warmer, allowing the good flights, which are then badly needed.

If the bees are taken out at a time when they can fly at once—and some beekeepers prefer this—they should be taken out in the early morning, so that they can have a good flight before night. Bees should not be taken from the cellar at a time when they can fly only a little, but they should either be taken out when they can not fly at all or at a time when they can fly freely almost at once. Bees in good condition rarely fly freely unless the outside temperature is as high as 60° F.

PREVENTION OF DRIFTING.

When the bees are taken from the cellar and placed on their summer positions they sometimes tend to leave the weaker colonies and on their return to collect in those with greater populations. This is known as "drifting." In general, the bees tend to drift toward the windward side of the apiary. Most frequently they join the hives that were first set out and which have established a strong flight by the time the neighboring colonies have first taken wing. The tendencies, therefore, are to join flying colonies, stronger colonies, and the end colonies in a row. The condition of the bees plays a large part in drifting, for if the bees are badly in need of a flight because of dysentery they go at once into the air without properly marking the location of their hive, and therefore are not able to find it when they return.

To prevent drifting, it is best to set the bees out when it is too cold for them to fly, so that as the weather warms, permitting flight, this will take place more naturally. It is also well to reduce the entrances so that as the bees leave the hive their tendency to orient themselves will be greater. It is claimed by some beekeepers that if the cellar is well aired the night before the bees are to be removed, they will be in better condition and will drift less, but it is not clear what difference this can make unless the clusters are made tighter because of lower temperatures.

Beekeepers have discussed the question whether, after removal, the bees should be placed on the same stands occupied by them the fall before. If the bees could remember their old location so that they would return to it, even after an interval of four months, it would be necessary, or at least desirable, to place each colony on the same stand which it occupied previously. There is no evidence, however, that the memory of the bees is so good, and it is usually the case that the bees of a colony will lose the memory of location within a week; therefore no attention need be paid to this feature.

PROTECTION OF THE HIVES IN THE SPRING.

The greatest objection to wintering bees in cellars is that after they are removed they are exposed to low temperatures. The ideal practice would be to pack the bees after taking them out in much the same way that bees are packed for outdoor wintering, but the work involved makes this impracticable. There can be no doubt that protection at this time would be beneficial. As has been pointed out, the apiary site should be one in which the hives are well protected from wind, and it is advantageous if the apiary grounds slope toward the south in order that the bees may have the fullest advantage of heat from the sun. If the bees have been wintered in the cellar in double-walled hives they will have the advantage of some protection when they are taken from the cellar. The beekeeper may feel safe in giving the bees all the protection possible at the time that they are taken from the cellar, knowing that it is impossible at this time or any other to insulate the hive too well.

In deciding whether the hives should be packed in the spring the beekeeper should be governed largely by the condition of the bees. If they have wintered well they will be able to stand greater extremes of temperature in the spring without loss, but if they have been wintered in a cold cellar they will be greatly injured by cold weather after they have been set out. Of course, the need of protection is determined chiefly by the kind of weather prevailing during the first few weeks after the bees have been taken from the cellar. In some seasons the weather is so fine that the bees would be little benefited by packing or other protection, but the beekeeper can not influence the weather, and the only safe plan is so to place the bees that if the weather does turn cold they will still be safe. Here, as everywhere else in beekeeping, it pays to be on the safe side, so far as protecting the bees is concerned.

PROVIDING BREEDING ROOM AND STORES IN THE SPRING.

After the main honey-flow is past it is usually desirable that each colony be kept in two hive bodies of full depth. Most producers of extracted honey do this, but too many producers of comb-honey are not adequately supplied with hive bodies and do not give the second body. These two hive bodies should be left with the bees at least until brood-rearing ceases, and at this time one of them should be removed if the bees are to be wintered in the cellar. As has been pointed out in other bulletins of the department, if the bees are wintered outdoors they will do better in the two hive bodies throughout the winter.

In the upper hive body will be found a considerable amount of the honey to be used by the bees up to the time of the next honey-flow. Usually there will be enough in the lower hive body for the bees while they are in the cellar, especially where comb-honey is produced, but if the lower hive body is not adequately supplied with winter stores (perhaps 15 to 20 pounds) the beekeeper should move some of the stores. It is also a good practice to winter the bees in the cellar in a hive containing the full stores, except that this makes it necessary to carry in hives weighing perhaps 80 pounds.

After the second hive bodies have been removed, if they contain honey they should be stored in a warm, dry place, where the honey will not be injured. If it is possible to place such hive bodies in the furnace room of the residence, this will be found to be ideal. If no such place is available, the beekeeper may keep these in a dry cellar or other location where the honey will not be exposed to rapid changes in temperature. For this purpose a place suitable for the storage of comb-honey is desirable. It should be pointed out that the honey in these combs should not be extracted. It will be needed for the building up of the colonies the next spring, and to remove it is simply to reduce the crop of the next season.

Some time within two weeks after the bees have been taken from the cellar, depending on the weather, each colony should be provided with its second hive body. Preferably, this should be placed underneath the hive body in which the bees were wintered in order that the propolis at the top of the hive may not be broken. At this time an examination of the colonies may be made from below to see whether any of them are queenless or require immediate attention for other reasons, but at this season there is little that the beekeeper can do that will help the bees other than to provide them with room for the brood and with adequate supplies of stores. Queens should not be clipped at this time, and usually not until settled weather has arrived. Further spring manipulation is not necessary and the bees are better off if the beekeeper lets them alone.

If the bees have been requeened at the proper time and if the total amount of stores is given as indicated, it will not be worth while to go through the bees to look for queenless colonies. The beekeeper should see to it that at least 45 pounds of honey are provided for each colony from the time of the last honey-flow in the fall to the beginning of the first main honey-flow of the following season. If this is not given in full, the beekeeper may be sure that the crop of the following year will be reduced. This amount of honey left for the use of the bees is a better investment for the beekeeper than money in the bank.

It should be pointed out that the giving of a second hive body in the spring is not simply a means of supplying additional stores, but more than one hive body will be needed for the development of the brood. A single 10-frame Langstroth hive is not large enough for the development of a good colony of bees, which, before the beginning of the main honey flow, should have brood to fill at least 12 frames.

As was stated earlier in this bulletin, a colony of bees from one season to the next needs three things in abundance—room for the development of the brood, stores of good quality, and protection from wind and cold. In cellar wintering the protection is given by putting the bees in the cellar; the room and stores must be supplied later or the population of the colony will be reduced at the critical time of the honey-flow. If the early sources of honey are abundant, the amount of honey advised will not be consumed. The wise beekeeper, however, does not gamble on the early honey-flows, but invests this honey as life insurance for his bees.

MEASURES OF SUCCESS IN CELLAR WINTERING.

It is often difficult for the beekeeper to know whether his bee cellar is giving the best results, for he may not have been able to determine from reading or the observation of other cellars whether it is satisfactory. The writers, therefore, have attempted below to give a few measures which the beekeeper may apply to his apiary and his cellar, so that he may be able to decide whether his methods of cellar wintering should be improved.

(1) During the winter a thermometer inserted in the entrance of the hive should show a temperature of at least 52° F.

(2) There should never be any condensed moisture on the covers of the hives, and certainly never any on the bottoms.

(3) While the cellar should be kept dark at all times, if a candle is held at the entrance of a hive at the end of January it should be several seconds before any of the bees break cluster. Frequently the cellar doors may be opened in March without disturbing the bees.

(4) There should never be many dead bees on the bottom of the hives. The live bees should be able to push them out as they die during the winter. The bees thus carried out will be found on the cellar floor just below the entrances. If there are bees all over the floor, it shows that these bees have flown from the hives— an indication of poor wintering.

(5) The bees should be quiet during the late winter. Noise at this time indicates that the bees are disturbed by an accumulation of feces, caused by low temperatures or poor food.

(6) If the bees were in good condition in the fall and have been wintered well, the loss during the winter will never be more than one-sixth of the total population of the hive. Such a loss is excessive, however, and in a well-wintered colony it may be as low as a hundred bees. This probably depends to a large extent on the age of the bees which go into winter, and if the temperature is right and the stores good there will be almost no loss of vigorous bees.

(7) The bees should not leave the hive while they are being carried from the cellar. If they do, it indicates that they are excited by an accumulation of feces.

(8) Before removal from the cellar there should be no spotting of the hives from dysentery. There may be a little spotting after the bees have had a free flight outside, but if this is small in amount it does not indicate a serious condition.

(9) When the bees are taken from the cellar there should be no moldy combs, for the cellar at the right temperature will be too dry for the growth of molds.

(10) There should be no brood when the colonies are taken from the cellar. Brood-rearing in the cellar is proof that the cellar is too cold or that the food used by the bees is inferior.

(11) Enough brood should be in each colony at the opening of the main honey-flow to fill completely 12 Langstroth frames.

(12) The population of the hive should not decrease appreciably after the bees are removed from the cellar. Such a condition, known as spring dwindling, is an indication of poor wintering. For three weeks after the hives are set out no new bees will be emerging, but the loss of bees during this time should be so small as not to be noticeable.

THE PRESIDENT TO THE FARMERS OF AMERICA.

[Extracts from President Wilson's message to the Farmers' Conference at Urbana, Ill., January 31, 1918.]

The forces that fight for freedom, the freedom of men all over the world as well as our own, depend upon us in an extraordinary and unexpected degree for sustenance, for the supply of the materials by which men are to live and to fight, and it will be our glory when the war is over that we have supplied those materials and supplied them abundantly, and it will be all the more glory because in supplying them we have made our supreme effort and sacrifice.

In the field of agriculture we have agencies and instrumentalities, fortunately, such as no other government in the world can show. The Department of Agriculture is undoubtedly the greatest practical and scientific agricultural organization in the world. Its total annual budget of $46,000,000 has been increased during the last four years more than 72 per cent. It has a staff of 18,000, including a large number of highly trained experts, and alongside of it stands the unique land grant colleges, which are without example elsewhere, and the 69 State and Federal experiment stations. These colleges and experiment stations have a total endowment of plant and equipment of $172,000,000 and an income of more than $35,000,000 with 10,271 teachers, a resident student body of 125,000, and a vast additional number receiving instructions at their homes. County agents, joint officers of the Department of Agriculture and of the colleges, are everywhere cooperating with the farmers and assiting them. The number of extension workers under the Smith-Lever Act and under the recent emergency legislation has grown to 5,500 men and women working regularly in the various communities and taking to the farmer the latest scientific and practical information. Alongside these great public agencies stand the very effective voluntary organizations among the farmers themselves which are more and more learning the best methods of cooperation and the best methods of putting to practical use the assistance derived from governmental sources. The banking legislation of the last two or three years has given the farmers access to the great lendable capital of the country, and it has become the duty both of the men in charge of the Federal Reserve Banking System and of the Farm Loan Banking System to see to it that the farmers obtain the credit, both short term and long term, to which they are entitled not only, but which it is imperatively necessary should be extended to them if the present tasks of the country are to be adequately performed. Both by direct purchase of nitrates and by the establishment of plants to produce nitrates, the Government is doing its utmost to assist in the problem of fertilization. The Department of Agriculture and other agencies are actively assisting the farmers to locate, safeguard, and secure at cost an adequate supply of sound seed.

The farmers of this country are as efficient as any other farmers in the world. They do not produce more per acre than the farmers in Europe. It is not necessary that they should do so. It would perhaps be bad economy for them to attempt it. But they do produce by two to three or four times more per man, per unit of labor and capital, than the farmers of any European country. They are more alert and use more labor-saving devices than any other farmers in the world. And their response to the demands of the present emergency has been in every way remarkable. Last spring their planting exceeded by 12,000,000 acres the largest planting of any previous year, and the yields from the crops were record-breaking yields. In the fall of 1917 a wheat acreage of 42,170,000 was planted, which was 1,000,000 larger than for any preceding year, 3,000,000 greater than the next largest, and 7,000,000 greater than the preceding five-year average.

But I ought to say to you that it is not only necessary that these achievements should be repeated, but that they should be exceeded. I know what this advice involves. It involves not only labor but sacrifice, the painstaking application of every bit of scientific knowledge and every tested practice that is available. It means the utmost economy, even to the point where the pinch comes. It means the kind of concentration and self-sacrifice which is involved in the field of battle itself, where the object always looms greater than the individual. And yet the Government will help and help in every way that it is possible.

It was farmers from whom came the first shots at Lexington, that set aflame the Revolution that made America free. I hope and believe that the farmers of America will willingly and conspicuously stand by to win this war also. The toil, the intelligence, the energy, the foresight, the self-sacrifice, and devotion of the farmers of America will, I believe, bring to a triumphant conclusion this great last war for the emancipation of men from the control of arbitrary government and the selfishness of class legislation and control, and then, when the end has come, we may look each other in the face and be glad that we are Americans and have had the privilege to play such a part.

THE BUSINESS OF AGRICULTURE.

[Extracts from addresses.]

The next great factor to enlist for the betterment of Agriculture and rural life in this Nation is the business man of the town and the city. He has not always been alive to his obligations. He has contented himself, in too many instances, with plans to secure profit in agricultural trade, instead of sympathetically and eagerly planning constructive assistance. This duty, pressing in peace time, is of the most urgent and impelling character in this crisis; and I appeal to the bankers and business men to see that they omit no effort to familiarize themselves with the agencies serving to aid the farmers and to promote wise plans to secure the necessary results.

D. F. Houston,
Secretary of Agriculture.

In the interest of our national development at all times and in the interest of war efficiency just now our agriculture must be well maintained. It should be remembered that the agricultural unit is a small unit. There are 6,000,000 farms in this country, each an individual unit. It is to the interest of persons who do not live on farms, even more than to the interest of those who do live on farms, that production shall be kept up. This means that all people, not farmers alone, but those who live in cities as well as the farmers, are interested in experimental and educational activities along agricultural lines as conducted by the Federal Government and the States. These efforts should be liberally supported.

R. A. Pearson,
Assistant Secretary of Agriculture.

In a time like this no man has a moral right, whatever his fortune may be, to employ another man to render any service of mere comfort or convenience. When the finest young men of the United States are in France digging ditches, sawing lumber, laying rails, and playing with death, and when the finest young women of the United States are scrubbing floors in hospitals, it is a sin that almost approaches the unpardonable offense against civilization for any man or women in the United States to engage in a wasteful or unnecessary service.

Clarence Ousley,
Assistant Secretary of Agriculture.

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PRODUCING FAMILY AND FARM SUPPLIES ON THE COTTON FARM

C. L. GOODRICH
Agriculturist

FARMERS' BULLETIN 1015

UNITED STATES DEPARTMENT OF AGRICULTURE

OFFICE OF THE SECRETARY
Contribution from the Office of Farm Management
E. H. THOMSON, Acting Chief

Washington, D. C. January, 1919

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HOME PRODUCTION OF SUPPLIES offers the Southern farm family an easy way to reduce the cost of living.

Because of the long growing season, and the short, mild winters of the Cotton Belt, garden vegetables may be grown there in abundance throughout the year with little labor and at trifling expense.

Necessary live-stock products and feeds for farm animals can be produced on the farm much more cheaply than they can be bought.

This bulletin suggests ways in which southern farmers may make the most of opportunities for the home production of commodities that otherwise would necessitate cash outlay.

PRODUCING FAMILY AND FARM SUPPLIES ON THE COTTON FARM.

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THE VITAL FACTORS of comfortable farm life are food, shelter, and fuel, and so far as these are present in quantity and quality beyond the necessities for mere existence the standard of living and the consequent health and happiness of the family increase.

At present, with a large part of the world on the verge of starvation, and with a shortage of food even in our own country, it is particularly fitting that every farmer produce foodstuffs and feeds in ample quantities to insure the welfare of the farm family and live stock and a surplus for the nonproducers of the community and the world at large.

Aside from the hygienic and social values, the abundance of the living furnished to the family by the farm is among the important factors that determine the amount of the net income of the farm and the safety and profitableness of the business. Hence the degree to which the farm is furnishing the family food and the farm feed should be one of the first tests of efficiency in farm management. On small farms the living furnished without money cost is often a vital matter, since the cash return of such farms is relatively small.

IMPORTANCE OF HOME PRODUCTION OF SUPPLIES.

In a group of 106 farms in Brooks County, Ga., in a community that makes a specialty of producing the farm food and farm feeds, the families in 1914 consumed food ranging in value from $104 to $1,283 per family, averaging $526. Approximately 85 per cent of this food was produced on the farm. That part of the food produced on the farm constituted an average of 18 per cent of the net income of farms having 250 acres or more of crop land and 48 per cent of the net income of farms having less than 75 acres of crop land. (See United States Department of Agriculture Bulletin No. 648.)

On 149 farms fairly evenly distributed in Gaston County, N. C., Troup County, Ga., and McLennan County, Tex., the average family consumed food to the value of $454. Of this 69 per cent was produced on the farm. (See United States Department of Agriculture Bulletin No. 410.)

The family garden and family live stock, which supply the larger part of the family food, are usually cared for at times when the work interferes comparatively little with the regular farm enterprises, and largely by labor that would otherwise be idle. Consequently these supplies can usually be produced on most farms at less cost than if they were bought elsewhere.

When a farmer makes a practice of producing the family food on the farm, this item, plus fuel and shelter furnished by the farm, has a value equal to the interest on the investment or rent for the entire farm up to a considerable size of business.

In the group of farms in Brooks County, Ga., mentioned above, the average value of food, fuel, and shelter furnished the family on farms of less than 75 acres of crop land was 1½ times as much as interest on the total investment at 8 per cent, and on farms of over 250 acres of crop land it averaged 48 per cent of the interest on the investment. On the entire group of 106 farms, averaging 145 acres of crop land, the food, fuel, and shelter furnished the family averaged 82 per cent of the interest on the average investment at 8 per cent.

Following is a list of the foods consumed by the average adult person on the 255 farms in North Carolina, Georgia, and Texas, mentioned above (two children of 12 years or under being considered equivalent to one adult).

Average annual consumption of various articles of food per adult person by 255 farm families in North Carolina, Georgia, and Texas.

Article.	Unit of measure.	Amount consumed per adult person.	Article.	Unit of measure.	Amount consumed per adult person.
Vegetables:			Fruit—Continued.		
Beans, green	Pecks	5.7	Grapes	Bushels	0.25
Beets	do	3.5	Berries	Quarts	11.5
Cabbages	Heads	14	Cereals:		
Cucumbers	Pecks	2	Corn meal	Pounds	136
Melons	Number	15	Flour	do	224
Onions	Pecks	1.5	Sirup	Gallons	4
Peas	do	1.13	Sugar (54 pounds)=sirup	do	8.2
Potatoes (Irish)	Bushels	2	Dairy products:		
Potatoes (sweet)	do	5.11	Butter		
Sweet corn	Dozen	6.8	Buttermilk =milk	Quarts	482
Tomatoes	Pecks	4.1	Milk		
Turnips	do	4.5	Beef	Pounds	12
Fruit:			Pork and lard	do	138
Apples	Bushels	1.4	Poultry products:		
Pears	do	.3	Poultry	do	57.5
Peaches	do	1.5	Eggs	Dozen	28.4

THE VEGETABLE GARDEN.

In the colder parts of the country many farmers, knowing the value to health and happiness of a variety and abundance of freshly gathered vegetables for home consumption, not only provide a good summer garden but also go to considerable expense in building cold frames and hotbeds to give an early start to some of the spring and summer vegetables, and sometimes even to grow certain vegetables in the winter. In addition to these devices for lengthening the growing season, they provide winter storage for an ample supply of such fruits and vegetables as can be kept, although these safeguards add greatly to their cost.

The southern farmer has an advantage over the northern farmer in a long growing season and a short, mild winter, and does not require such extensive equipment for the maintenance of his supply of vegetables. With little extra effort he can have an abundance of fresh vegetables in great variety throughout the year, with very little need of artificial protection unless it be for a few weeks during the winter along the northern border of the cotton belt. Throughout the cotton area cabbage, collards, kale, spinach, turnips, parsnips, carrots, lettuce, and radishes will grow in the open in the winter.

The net returns for labor expended on a good farm garden are perhaps greater than those from any other area of equal size on the farm,, partly because of the more intensive character of the garden enterprise and partly because the garden can be cared for by labor that otherwise would not be utilized.

SIZE OF THE GARDEN.

The size of the garden necessary to supply vegetables for a family of a given number of persons will be influenced largely by the climatic conditions, the fertility of the soil, the likes and dislikes of the family, and the method of cultivation of the garden, whether largely by horse labor, by man labor, or by a combination of both.

There are very few detailed records of farm gardens giving the size and actual production and cost.

The farmers in the group of farms in Brooks County, Ga., mentioned above, planted an average of one-fourth of an acre in potatoes (mostly sweet potatoes) per adult person, or equivalent, in the family, and one-eighth acre in other vegetables. Potatoes to the value of $3.55 per person were sold, the remainder being used on the farm. Watermelons were not included in the garden, as most of the farms grow melons for shipping, and the families were supplied from the farm crop. The 12 farmers who planted melons for home use alone planted 32 hills 10 by 10 feet, or a little over one-thirteenth of an acre, for each adult, or adult equivalent, in the family. These Brooks County farms are on the lighter Coastal Plain soils, where yields are moderate, and the farmers made liberal provision for the family.

Farmers' Bulletin 602 gives interesting and valuable information on the sizes of gardens and the value of products for some southern town families. One group of 35 town families is cited which raised an average of nearly $50 worth of vegetables on gardens ranging in size from 300 to 499 square yards. A group of 543 town gardens, averaging 723 square yards, or about one-seventh of an acre, produced an average of $29.87 worth of vegetables. The average cash outlay for these gardens was:

Labor	$1.51
Seeds	1.51
Fertilizer	.52
Total	3.54

The labor expenditure was limited practically to the cost of having the garden plowed and harrowed for planting. Little or no labor was hired during the season, the planting and care of the garden in all cases being done by the family.

One of these home gardeners, a laborer at Charlotte, N. C., on five-eighths of an acre of ground, produced dry beans, peas, onions, cabbages, turnips, beets, cucumbers, tomatoes, sweet corn, and peppers to the value of $92, at a cash expense of only 15 cents for some seed. This man is thrifty and saves most of his seed. These vegetables, with the exception of $2.80 worth sold, were cared for and consumed by a family equivalent in size to seven and a half adult persons.

A driver at Cliffside, N. C., on a little over three-fourths of an acre, produced 11 kinds of vegetables, to the value of $97.20, at a cash outlay of $5 for preparation and $2 for seeds. The family of four cared for the garden and consumed all the vegetables, with the exception of $4.50 worth that were sold.

A gardener at Drayton, S. C., on a little less than three-fourths of an acre, produced 14 vegetables to the value of $72.65, at a cash outlay of $7.50 for preparation, $3.20 for seeds, and $6 for fertilizers. These vegetables were all consumed by the family, equivalent to six adult persons.

Another home gardener on 1¼ acres, with a family equivalent to five adult persons, produced vegetables to the value of $86.90, at a cash expense of $2.50 for preparation, $1.60 for seeds, and $3.10 for fertilizers, a total outlay of $7.20. Twenty-eight dollars' worth of these vegetables were sold and 42 quarts were canned for winter use.

A clerk at Williamston, S. C., with a family equivalent to three adult persons, on one-third of an acre produced 10 bushels of sweet potatoes, 27 bushels of Irish potatoes, 4 bushels of green beans, 1 gallon of garden peas, 3 bushels of onions, 200 heads of cabbage, 10 pecks of turnips, 8 pecks of beets, 8 pecks of cucumbers, 26½ bushels of tomatoes, 12 cantaloupes, 24 dozen ears of sweet corn, 10 bushels of lettuce, 100 collards, 2 pecks of peppers, 1 bushel of okra, a few squashes, and 3 bushels of peanuts, valued altogether at $89. The cash expenditure on this garden was for preparation, $2; for seeds, $4.80; for fertilizer, $1.20; for extra labor, $1.50; a total expenditure of $9.50. Fifty-four dollars' worth of vegetables were sold and 100 quarts canned for winter use.

PLANNING THE GARDEN.

For ease in care of the farm garden and to save time and labor, it is desirable to lay it off so that it can be plowed and cultivated largely with horse tools. Plant everything in long, straight rows and make the rows far enough apart for horse implements in working the crops.

List the long-season crops in one group and the short-season and succession crops in another in the order of their planting dates and let this determine the order of planting in the garden. This will tend to keep the unplanted part in a single piece so that it will be more easily kept in condition for the later plantings and will make it possible to clear up larger areas for succession planting or for second-crop plantings.

For reference in planning the farm garden and determining the proper size for the family needs, the following average yields per 100 feet of row are given. Plan to have a surplus, then there will always be enough.

Yields of garden vegetables.

Vegetable.	Yield per 100 feet of row.	Vegetable.	Yield per 100 feet of row.
Asparagus......bunches..	50	Melon:	
Beans, snap:		Muskmelon......melons..	60
Spring......pecks..	[illegible]	Watermelon......do....	15
Fall......do....	4	Okra......pecks..	6
Beans, Lima, in pod......do....	7	Onions......do....	3
Beets:		Parsnips......do....	8
Thinnings for greens......do....	3	Peas in the pod......do....	2.5
Roots......do....	12	Peppers......do....	9
Cabbage:		Potatoes:	
Spring......heads..	40	White......do....	3
Fall......do....	25	Sweet......do....	4
Carrot......pecks..	5	Salsify (oyster plant)......do....	5
Cauliflower......heads..	25	Spinach......do....	8
Kohl-rabi......pecks..	10	Squash:	
Corn, sweet......ears..	50–75	Summer......squash..	50
Cucumbers......pecks..	7	Winter......do....	25
Eggplant......fruits..	74	Tomatoes......pecks...	12
Kale......pecks..	12	Turnips......do....	10
Lettuce......heads..	50–100		

The following table gives the earliest planting periods and the latest planting periods for the short season and succession crops, and the earliest planting period for long-season garden crops in the middle cotton belt.

Planting periods, width of row, and distance of plants in the row for garden vegetables in the middle cotton belt.

Vegetable.	Earliest planting period.	Latest planting period.	Distance apart.	
			Rows for horse cultivation.	Plants in the row.
			Feet.	
Cabbage	Jan. 15–Feb. 28	Aug. 15–30	3	1½ to 2 feet.
Collard	Feb. 1–28	do	3	Do.
Kale	do	Oct. 1–30	3	1 to 1½ feet.
Onion	do	Oct. 1–15	3	3 inches.
Pea (English)	Feb. 1–Mar. 15	do	3	3 to 4 inches.
Potatoes (white)	Feb. 1–28	Aug. 1–15	3	1 to 1½ feet.
Radish	do	Oct. 1–15	3	2 to 3 inches.
Turnip	do	do	3	3 to 6 inches.
Beet	Feb. 15–Mar. 15	Aug. 1–30	3	6 to 8 inches.
Carrot	do	do	3	4 to 6 inches.
Cauliflower	do	do	3	1½ to 2 feet.
Kohl-rabi	do	do	3	4 to 8 inches.
Celery	do	Aug. 1–Sept. 30	3	6 to 12 inches.
Lettuce	do	Oct. 1–15	3	8 to 12 inches.
Mustard	do	do	3	Do.
Spinach	do	do	3	4 to 6 inches.
Beans, snap	Mar. 1–30	Aug. 15–30	3	5 to 10 inches.
Corn, sweet	do	Aug. 1–15	3	12 to 18 inches.
Sweet potato	Mar. 15–Apr. 15	July 15–30	3	Do.
Tomato	do	July 15–Aug. 15	4	3 feet.
Asparagus	Feb. 15–Mar. 15		4	2 feet.
Brussels sprouts	do		3	Do.
Parsnip	do		3	4 to 6 inches.
Salsify	do		3	Do.
Bean, lima	Mar. 15–Apr. 15		4	4 feet.
Cucumber	do		6	15 to 18 inches.
Eggplant	do		3	18 to 24 inches.
Melon, water	do		9	9 feet.
Melon, musk	do		6	15 to 18 inches.
Okra	do		3	3 feet.
Pepper	do		3	12 to 18 inches.
Squash, summer	do		6	4 feet.
Squash, winter	do		9	9 feet.

For hand cultivation, the distance apart of the rows of kale, onion, radish, turnip, beet, carrot, celery, lettuce, mustard, spinach, parsnip, and salsify may be reduced to 18 or even 15 inches.

The following garden planting plan is suggested for an average family of 5 mature persons, or their equivalent, 2 children under 12 being regarded as one mature person.

Ease in cultivation with horse tools is provided for by making the rows 200 feet long and none of them less than 3 feet apart. If it is desired to do most of the work with hand tools the distances apart of the rows of the smaller vegetables may be reduced to 18 inches or even 15 inches in some cases, thus reducing the area covered by the garden.

Suggested planting of vegetables for a farm family of 5 adults or their equivalent in the middle cotton belt. Size of plot 200 feet long by 144 feet wide, rows 200 feet long.

Row No.	Row space.	Earliest planting period.	First crop.	Final plantings.	
				Period.	Crop.
	Feet.				
1	4	Feb. 15–Mar. 15	150 feet asparagus, 50 feet herbs		
2	3	Jan. 1–Feb. 28	Cabbage, lettuce between cabbages.	Aug. 1–15	Sweet corn.
3	3	Feb. 1–28	Early white potatoes	do	Do.
4	3	do	do	do	Do.
5	3	do	Early garden peas	Aug. 30	Cauliflower.
6	3	do	Early turnips (radishes to mark rows).	Aug. 15–30	Green beans.
7	3	do	Green onions (from sets)	do	Cabbage.
8	3	Feb. 15–Mar. 15	Spinach	do	Do.
9	3	do	Cauliflower	Sept. 15–Oct. 15	Spinach.
10	3	do	100 feet early beets, 100 early carrots.		
11	3	do	Dry onions from seed (radishes to mark rows).		
12	3	do	do		
13	3	do	100 feet parsnip, 100 feet salsify (radishes to mark rows).		
14	3	Mar. 1–30	Medium garden peas	Aug. 1–30	Celery.
15	3	do	Snap beans	Oct. 1–15	Turnip.
16	3	do	Early sweet corn	do	Kale.
17	3	Mar. 15–Apr. 15	Early sweet potato	do	Green onions.
18	3	do	do	do	Beets.
19	3	Apr. 1–30	Medium early snap beans	do	Collards.
20	3	do	Medium early sweet corn		
21	3	do	do		
22	4	Mar. 15–Apr. 15	Early tomatoes		
23	4	do	Medium early tomatoes		
24	4	do	Pole Lima beans		
25	3	do	100 feet egg plant, 100 feet pepper		
26	3	do	Okra		
27	6	do	100 feet cucumber, 100 feet summer squash		
28	6	do	Muskmelon		
29	9	do	Watermelon		
30	9	do	do		
31	9	do	do		
32	[illegible]	do	Winter squash		
33	4	May 1–30	Main crop tomatoes		
34	4	do	do		
35	3	do	Third planting sweet corn		
36	3	do	do		
	144				

A garden laid out according to this plan would contain a little less than two-thirds of an acre. In addition it is advised that one-half acre of late sweet potatoes and one-third of an acre of late white potatoes be planted to provide a winter supply of these vegetables. It is suggested that cowpeas or some other catch crop be planted between the rows of the long-season crops at their last cultivation and that fall and winter cover crops be planted on ground not occupied by vegetables all the season, these crops to be turned under for improving the soil.

In the northern part of the cotton belt a desirable feature would be a cold frame or hotbed to give an early start to early cabbage, cauliflower, lettuce, tomatoes, egg plants and peppers.

It is not the function of this bulletin to discuss varieties or methods of cultivation and care of vegetables. For this information the reader is referred to Farmers' Bulletin 934, United States Department of Agriculture, on Home Gardening in the South, and to special bulletins of the State Colleges and Experiment Stations on the subject.

THE FRUIT GARDEN.

Every farm should have a fruit garden as well as a vegetable garden, and it is suggested that for the average farm family one-half acre be devoted to this purpose.

Extending the lines of the above-suggested vegetable garden for 150 feet will give a space 150 by 144 feet, or practically one-half acre. The following plan is suggested for the fruit garden:

Space 15 feet.
First row, 5 apple trees, 30 feet apart.
Space 30 feet.
Second row, 5 apple trees, 30 feet apart.
Space 25 feet.
Third row, 3 pear, 2 fig, 2 plum, 20 feet apart.
Space 20 feet.
Fourth row, 3 Japanese persimmon, 4 peach, 20 feet apart.
Space 20 feet.
Fifth row, 7 peach, 20 feet apart.
Space 15 feet.
Sixth row, 14 grape vines, 10 feet apart.
Space 10 feet.
Seventh row, 25 dewberries, 5 feet apart, 1 Scuppernong grape.
Space 9 feet.

Strawberries may be planted between the rows of fruit trees until the trees become so large as to shade the ground.

For varieties, culture, and care of these fruits the reader is referred to special bulletins of the State Colleges and Stations. The above plan of fruit garden is adapted from Extension Service Circular 13 of the Alabama Polytechnic Institute. The reader is referred to this circular for further suggestions on the arrangement of the fruit garden and for suggestions on varieties of fruits and their care and culture.

CEREALS.

Twelve to eighteen bushels, or practically one acre, of corn should be provided for the average family to fully supply meal for the family and provide toll for grinding and seed for planting.

It will probably not be practicable to grow wheat for the family flour in all parts of the South, but on the heavier soils and in regions where wheat does fairly well and there are local facilities for grinding, at least 35 bushels or 3 acres of wheat at the average yield of about 12 bushels per acre should be provided per family for family needs, toll for grinding, and seed for replanting.

SIRUP AND SUGAR.

It was found that the average adult person in 255 southern families consumed 4 gallons of sirup and 54 pounds of sugar per year. The sugar was for the most part bought of stores. Now this sugar can be easily manufactured on the farm by boiling sirup a little longer, until it granulates. One gallon of sugar-cane sirup will make 6.6 pounds of sugar, and 8.2 gallons of sirup will supply 54 pounds of sugar consumed by the average person. This with the 4 gallons consumed as sirup will mean the provision for 12.2 gallons per person to supply sirup and sugar, or for an average family of 5 adult persons, 61 gallons of sirup. One-half acre of sugar cane at average yields will produce this sirup and sugar.

ANIMAL FOODS FOR THE FAMILY.

Farm management studies indicate that farms which carry enough productive live stock to furnish milk, meat, poultry, and eggs for the family and have a surplus for sale, pay better than those that do not follow this practice.

MILK, BUTTER, AND COTTAGE CHEESE.

In planning to provide dairy products for the home, the size of the family, size of the farm, pasture facilities, market for surplus products, etc., must be considered. In these brief suggestions no attempt will be made to consider them all. A good equipment of family live stock is suggested for the average family, and it is left to the farmer to use his good judgment in adjusting the suggested plant to local conditions and to suit the needs of his individual farm.

The plan suggested is that two cows be provided for each average farm family, insuring an ample milk supply every day in the year; that they freshen six months apart, preferably spring and fall; that they average 2 gallons each of milk per day for 10 months in the year; and that they be milked for an average of 6 years and then turned into beef.

If these cows begin to give milk when between two and three years of age, and are turned into beef during the years when they become eight years old, they will have produced milk practically six years, and if a difference of three years is maintained between their ages, it will be necessary to save a calf every three years to replace them.

On this basis an average of four to five calves may be expected from two cows every three years, with the probability that at least two of them will be heifer calves, which will be ample to maintain the family herd of two cows.

High-grade community bulls of the dairy type should be maintained on farms and by farmers particularly adapted to their care.

There will be an average of three to four calves to be disposed of during each three-year period. When there is plenty of surplus milk some of these calves will be made into veal. If there is plenty of pasture and cheap roughage on the farm, some of the calves will be grown to feeder size to sell to farmers making a business of feeding, or they may be fattened on the home farm. The cows when they have passed their usefulness as milkers will be fattened on the farm or sold to feeders, who will convert them into beef. A supply of surplus calves of the kind this plan will produce will soon develop those farms in the community that are adapted to it into cattle-raising and cattle-feeding farms.

Some farmers will not care to raise their dairy cows but will prefer to buy them after they have reached the milking age. If such farmers will maintain community bulls of a beef type, the calves will be in greater demand among beef-producing farms and will produce a better grade of beef than pure dairy stock.

One community of farmers in the cotton belt takes care of its beef needs in the following manner: A beef club of 15 farmers was formed. Each member of the club agrees to grow, fatten, and dress at least one beef animal every 15 months for distribution among the members of the club. By following this system in regular rotation there is fresh beef for distribution every month.

Such plans as that outlined above systematically carried out, will go a long way toward furnishing the farm and a large part of the nonproducing village and town population with dairy products and beef. There are farms in nearly every southern community on which are kept enough cattle to supply the family needs, but many do not measure up to this standard.

PORK AND PORK PRODUCTS.

To supply the pork and pork products for the average farm family at least one pig should be raised per adult person or equivalent. This should provide the 138 pounds of pork products consumed by the average adult (see page 4), with a small surplus for sale.

If the family is a small one it may be more satisfactory to buy the pigs than to produce them on the farm, but in the case of a large family it will pay to keep a brood sow to raise the pigs. In most communities in the cotton States there is room for at least one farmer to do a thriving business by producing pigs for sale as weanlings to neighboring farmers.

The few pigs necessary to supply pork products for home consumption can live largely on waste products from the farm, garden, and orchard, and on scraps from the kitchen.

CHICKENS AND EGGS.

A flock of 30 to 50 fowls (exclusive of young chickens) properly selected and cared for will furnish all the eggs and poultry meat needed and some surplus to exchange for groceries. A flock of this size can be kept at small cost, since they will obtain part of their feed from insects, weeds and weed seeds, waste grain in the barnyard, etc. They may be cared for entirely by members of the family who take no part in the field work. Under such circumstances the keep of a small flock costs very little, and such a flock will add greatly to the supply of food on the farm.

FEED FOR THE FAMILY LIVE STOCK.

The feeds suggested below for the family live stock are not necessarily the best for all farms and all conditions. They are suggested simply because they are good staple feeds and also for the purpose of illustrating the method of procedure in making provision for the needs of the farm. Other feeds of equivalent feeding value may be substituted according to the judgment of the person making provision for the farm needs.

THE COWS.

Feed for the two cows, and young stock equivalent to one-third of a mature cow per year, is calculated on the basis of pasture for the 6 summer months, 10 pounds of cowpea hay, 5 pounds of oat hay, and 10 pounds of corn roughage per day for each cow for the remaining 180 days of fall, winter, and spring, and 1 pound of grain per 3 pints or 3 pounds of milk per day for the cows giving milk for the milking period of 44 weeks, the grain feed to be, say, three-fifths corn-and-cob meal and two-fifths cottonseed meal or their equivalents.

This will call for 1 ton of corn-and-cob meal and 1,234 pounds of cottonseed meal and 5.25 tons of roughage constituted of 4,200 pounds of corn roughage, 2,100 pounds of oat hay, and 4,200 pounds of cowpea or velvet bean hay.

On the basis of average yields per acre for the cotton States of 17½ bushels of corn, 20 bushels of oats, 12 bushels of wheat, three-fourths of a ton of oat hay, three-fourths of a ton of cowpea hay, and 200 pounds of cottonseed meal, to feed the family dairy herd will require 2 acres of corn, 6¼ acres of cotton, 1.5 acres of oat hay, 3 acres of cowpea hay, and the roughage from about 7 acres of corn.

These acreages should furnish sufficient grain for feed, toll for grinding, and seed for the next year's planting, besides sufficient roughage for liberal feeding.

A good Bermuda pasture of 5 acres or its equivalent in other pasture should be provided. This will provide summer grazing for the cows, the hogs, and the poultry. Two acres in rye, corn, and sorghum to be fed green would help out in case of short pasture during the spring and summer. (For aid and instruction on the feeding and care of the cows see Farmers' Bulletin 743 on the Feeding of Dairy Cows.)

THE HOGS.

The pigs will secure a large part of their feed by grazing in the cow pasture, on winter cover crops and on cowpeas and peanuts grown between the corn rows. Allowing 5 bushels of corn per head for finishing the 5 pigs necessary for an average family will require 25 bushels, or the corn from 1.5 acres.

THE CHICKENS.

The flock of fowls will pick up much of their feed from waste scattered over the farm. However, to insure good production of eggs and chickens, it will be wise to provide 70 pounds of grain per fowl, or, say, three-fourths bushel of corn and 1 bushel of oats per fowl for the 40 fowls. This will mean 30 bushels of corn and 40 bushels of oats, which at the average yields will require 2 acres of corn and 2 acres of oats.

THE WORK STOCK.

The work stock in the South is usually fed on grain and dry roughage during the fall, winter, and early spring. During the remainder of the year this is supplemented on many farms by pastures and green feed such as rye, sorghum, and corn.

A fair provision per head of work stock would be 60 bushels of corn, 40 bushels of oats, and 3 tons of roughage—say 1½ tons of cowpea hay or velvet bean hay, 1 ton of oat straw, and one-half ton of corn roughage. To provide this feed at average yields will require per head of work stock 3½ acres of corn, 2 acres of oats, 2 acres of cowpea hay and 1 acre of pasture and green feed.

ACRES NEEDED TO SUPPORT A 2-MULE FAMILY FARM.

On the basis of the garden and feeding program suggested and at average yields per acre for the South, the following acreages of food and feed crops will be required to feed properly a 2-mule family farm, averaging 5 adult persons or their equivalent:

	Acres.	Acres.
Garden:		
White potatoes	⅓	
Sweet potatoes	½	
Other vegetables	⅔	
Fruit	½	
		2
Corn with cowpeas:		
Grain for family (meal)	1	
For 2 cows	2	
For 40 chickens	2	
For 5 hogs	1½	
For 2 head work stock	7	
		13½
Roughage for cows and work stock		(13½)
Sugar cane, sirup and sugar for family		½
Oats and oat hay:		
For cows	1½	
For chickens	2	
For work stock	4	
		7½
Cowpea or velvet bean hay:[1]		
For cows	(3)	
For work stock	(4)	
		(7)
Soiling crops, for cows		2
Cotton seed, for cows[1]		(6¼)
Pasture:		
For cows and hogs	5	
For work stock	2	
		7

This totals practically 25½ acres of crop land and 7 acres of pasture, or 12¾ acres of crop land and 3½ acres of pasture per head of work stock. A second crop is taken from 7 of the 25½ acres and cowpeas or peanuts should be planted between the corn rows. This calculation aims to furnish the family liberally with food and to feed the farm live stock liberally. The vegetable and fruit gardens provided for are of sufficient size and variety of product to furnish an ample supply of fresh vegetables and fruits for the average cotton-belt family throughout the year, as well as enough for canning purposes. There should be a surplus of garden stuff, dairy and poultry products to sell or exchange for groceries.

The acreages are calculated on the basis of average yields. Average yields have been used simply by way of illustration. Many farms produce better yields, and those with average or lower than the average yields should better them. With higher yields less acreage will be needed to furnish family and farm needs, and the estimates given above can be cut down or maintained and the surplus sold.

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[1] Figures in parentheses are for by-products or second crops.

Farm management studies in the Southern States indicate that the best paying farms not only produce the necessary farm feeds but also have a surplus to sell, and usually on those farms that have a surplus the live stock is of better quality and is better cared for than on those farms that buy staple farm feed.

PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE RELATING TO THE FARM HOME.

Principles of Nutrition and Nutritive Value of Food (Farmers' Bulletin 142).
Food for Young Children (Farmers' Bulletin 717).
How to Select Foods:
  I. What the Body Needs (Farmers' Bulletin 808).
  II. Cereal Foods (Farmers' Bulletin 817).
  III. Foods Rich in Protein (Farmers' Bulletin 824).
Fresh Fruit and Vegetables as Conservers of Other Staple Food (Farmers' Bulletin 871).
What the Farm Contributes Directly to the Farmer's Living (Farmers' Bulletin 635).
Home-made Fireless Cooker and Its Use (Farmers' Bulletin 771).
Corn Meal as a Food and Ways of Using It (Farmers' Bulletin 565).
Honey and its Use in the Home (Farmers' Bulletin 653).
The Home Vegetable Garden (Farmers' Bulletin 255).
Home Gardening in the South (Farmers' Bulletin 934).
Control of Diseases and Insect Enemies of the Home Vegetable Garden (Farmers' Bulletin 856).
The Home Fruit Garden (Farmers' Bulletin 154).
Preparation of Vegetables for the Table (Farmers' Bulletin 256).
Use of Fruit as Food (Farmers' Bulletin 293).
Care of Food in the Home (Farmers' Bulletin 375).
Economical Use of Meat in the Home (Farmers' Bulletin 391).
Canned Fruit, Preserves, and Jellies (Farmers' Bulletin 203).
Canning Peaches on the Farm (Farmers' Bulletin 426).
Canning Tomatoes at Home and in Club Work (Farmers' Bulletin 521).
Farm Butter Making (Farmers' Bulletin 541).
The Feeding of Dairy Cows (Farmers' Bulletin 743).
Storage of Vegetables (Farmers' Bulletin 879).
Sugar-cane Culture for Sirup Production in the United States (U. S. Department of Agriculture Bulletin 486).
Sorghum Sirup Manufacture (Farmers' Bulletin 477).
Muscadine Grape Sirup (Farmers' Bulletin 758).
Poultry Management (Farmers' Bulletin 287).
Hints to Poultry Raisers (Farmers' Bulletin 528).
Poultry House Construction (Farmers' Bulletin 574).
Swine Management (Farmers' Bulletin 874).

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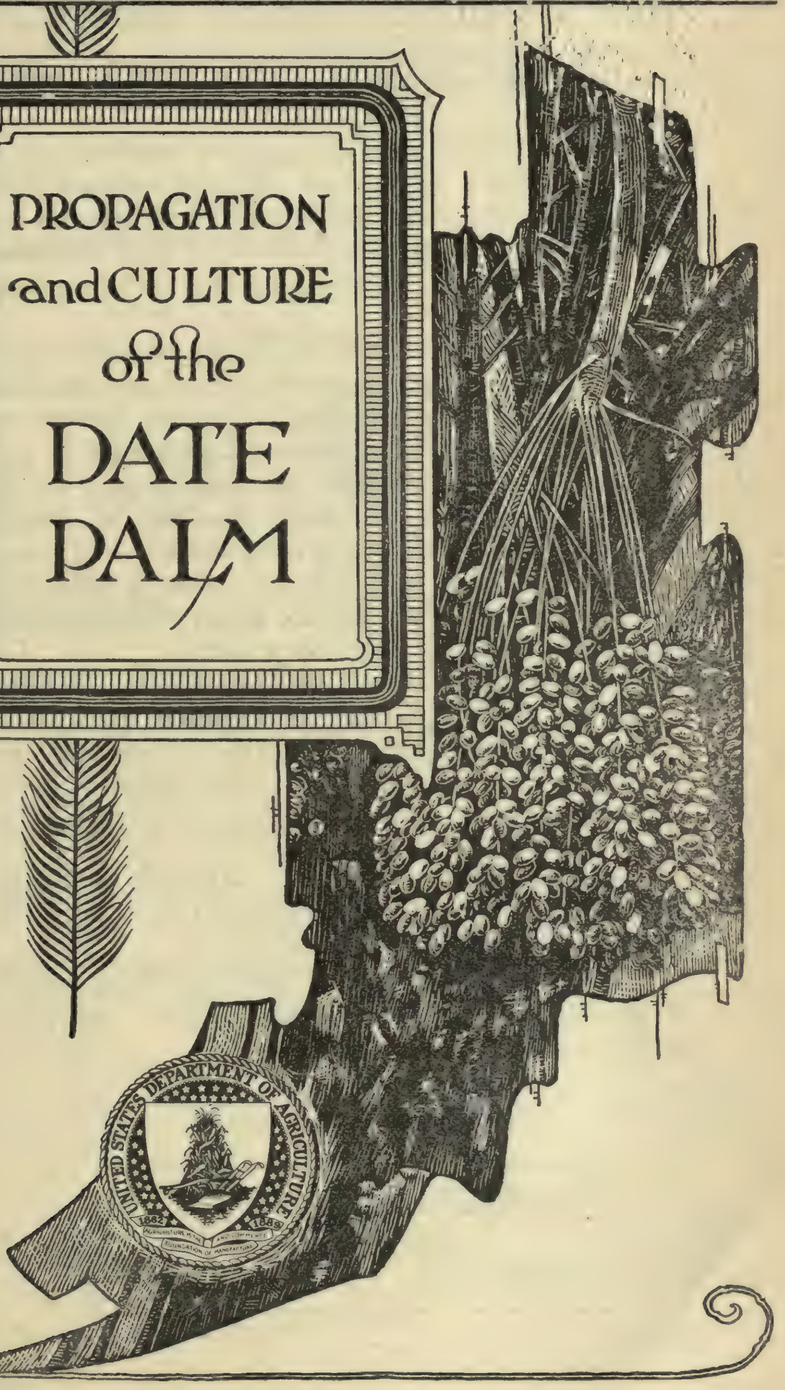
FARMERS' BULLETIN 1016
UNITED STATES DEPARTMENT OF AGRICULTURE

PROPAGATION and CULTURE of the DATE PALM



THIS BULLETIN is intended to furnish growers with definite instructions for the rooting of date offshoots and for their subsequent care in the orchard.

The only thoroughly satisfactory method yet devised for rooting young date offshoots consists in the use of a heavily manured nursery bed covered by a frame or shed so constructed as to give maximum heat and humidity. Water must be applied in ample and regular quantities.

Frequent irrigation and the maintenance of a high degree of soil fertility by the use of manure, mulches, and cover crops are essential to healthy growth and to the production of fruit in paying quantities.

First-class dates suitable for market can be produced only on soils in a high condition of fertility and tilth. This condition is most readily maintained on a well-drained sandy loam. Heavy soils need special attention to insure the proper penetration of the roots and distribution of water.

Localities where the settling of cold air causes the formation of dew during the ripening period may prove fatal to the more susceptible varieties of fruit.

The pruning of bearing palms should consist merely in the removal of old leaves, up to the fruit stems of the former crop.

Young palms should not be allowed to produce heavy crops of fruit, as this would be done at the expense of offshoot growth.

At the present stage of the industry the production of offshoots of proved varieties is of paramount importance.

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief
Washington, D. C. **January, 1919**

PROPAGATION AND CULTURE OF THE DATE PALM.

Bruce Drummond,
Assistant in Arboriculture, Crop Physiology and Breeding Investigations.

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ESTABLISHING DATE GARDENS IN CALIFORNIA.

EARLY in the present century two experimental date orchards were established in the Coachella Valley, Cal., one at Mecca (in 1904) by the Bureau of Plant Industry of the United States Department of Agriculture in cooperation with the horticultural department of the University of California, and the other at Indio (in 1907) by the Bureau of Plant Industry. A large number of the best date varieties of the Old World have been tested in these gardens.

For several years date culture offered little promise of immediate commercial success. Two factors were largely responsible for the doubtful conditions then existing—the difficulty experienced in ripening the fruits and the failure of many attempts to root offshoots of desirable varieties.

In 1910 a slow-maturation process of ripening the fruit of the Deglet Noor variety was discovered. This gave assurance of successful production in areas of high temperature adapted to the culture of dates of superior quality. The problem of rooting offshoots has now been worked out and no longer offers unusual difficulties.

It is the purpose of the present paper to give concise practical directions for propagating date palms by offshoots and for establishing a bearing orchard. The picking, curing, and packing of the fruit will not be considered at this time.

PROPAGATION OF THE DATE PALM.

The date palm is propagated either by seed or by offshoots. No other method is known.

PROPAGATION BY SEED.

Seed may be planted from the best varieties, but with no assurance to the grower that he will get a large percentage of commercial dates. Of the trees grown from seed 50 per cent are males. Male trees produce no fruit, but do produce pollen-bearing flowers that the date grower must have in order to pollinate or fertilize the flower spikes when they appear on the female or fruit-producing trees. The grower therefore needs a few select male trees for this purpose.

PROPAGATION BY OFFSHOOTS.

The offshoot of the date palm is a bud in the axil of the leaf; hence it is a direct product of the growing stem and in variety the same as the parent plant.

In some cases individual trees develop the offshoot buds much earlier and more rapidly than others of the same variety, and the varieties differ very markedly in their offshoot-producing habits. Generally, young palms should begin to produce offshoots in the third year and continue to produce them until the tenth or twelfth year. It has been found that varieties differ both in the length of time during which offshoots are produced and in the total number produced.

POSITION OF THE OFFSHOOTS ON THE TREE.

The first offshoot buds which develop are situated at or very near the base of the palm. After the third year these buds develop very rapidly, and at the end of the fourth or fifth year the grower should be able to cut an average of one or two offshoots for every tree in the orchard. Offshoot buds very often develop on the trunk of a palm from 2 to 4 feet above the base. Some varieties have been known to produce offshoots 6 feet above the ground, but this is very unusual in the Coachella and Imperial Valleys in southern California on account of the extremely dry atmospheric conditions. Along the coast in southern California, where heavy fogs and cooler temperatures prevail, the date palm seldom produces fruit, but will produce offshoots indefinitely. Offshoots 20 feet from the ground have been found growing on the trunks of old date palms at Santa Barbara, Cal.; also near the old town of Westminster in Orange County. Varieties at the cooperative date garden at Tempe, Ariz., have developed offshoot buds 6 and 8 feet above the ground on the trunks of palms that were 15 years old.

SIZE OF OFFSHOOTS WHEN READY FOR REMOVAL.

The proper size which the offshoot should attain before being cut from the mother palm has been the subject of much study and experiment. No data are available as to how large or how small an offshoot can be cut and rooted safely. It has been found that a medium-sized offshoot, weighing from 10 to 12 pounds, if well formed, of compact growth, and in good general condition, can be cut and rooted successfully, provided the grower can give the attention necessary for growing the offshoots in his own garden.

Large offshoots, weighing from 20 to 30 pounds, in many instances are very slow to start root growth, this delay being caused no doubt by the maturing and drying out of the shoot where cut. The standard size for cutting may be well placed at 12 pounds. To estimate the weight of an offshoot on the tree the following measurements may be used: When the diameter of the offshoot just above the base is 5½ inches it will weigh about 12 pounds; with a diameter of 6½ inches the offshoot will weigh 14 to 15 pounds. A slight variation may occur on account of differences in the method of pruning.

THE BEST TIME FOR CUTTING OFFSHOOTS.

Offshoots of various sizes and weights have been cut in every month of the year in order to determine the most favorable time for cutting. The date palm, unlike most other fruit trees, seldom has a dormant period during which growth ceases entirely. The cold period of December and January, when growth is at the lowest ebb, has not been found a favorable time for cutting the offshoots, and the period of the greatest summer heat, when growth is most active and the tissues are full of fermentable material, has proved still more unfavorable. For southern California and Arizona the most favorable time has been found to be from February 1 to May 1. Offshoots cut at this time not only resist the shock much better, but all exposed tissue hardens rapidly, which lessens the danger of fermentation after the offshoot is transplanted to the nursery.

PRUNING OFFSHOOTS PREPARATORY TO CUTTING.

Before cutting the offshoot it is necessary to prune back the inner leaves fully one-half their entire length. The outside leaves may be pruned back two-thirds of their length, leaving high stubs to protect the inside or crown leaves when the offshoot starts new growth. (Fig. 1.) It is not necessary to prune the offshoot until it is a mere stub, as such pruning will cause it to ferment very quickly unless growth starts immediately. Four to six days before cutting them is the best time to prune the offshoots. The pruning of young shoots on the mother plants will not injure them, and at times, where a congested growth of the bud has been caused by the base of the leaf being held so firmly against the trunk that the offshoot bud has no chance to expand to its natural form, pruning is necessary.

IMPROVED METHOD OF REMOVING OFFSHOOTS.

The cutting of a date offshoot from the parent tree is a very critical operation and should be done only with the proper tools, and, if possible, by or under the supervision of some one who has had previous experience in this work.

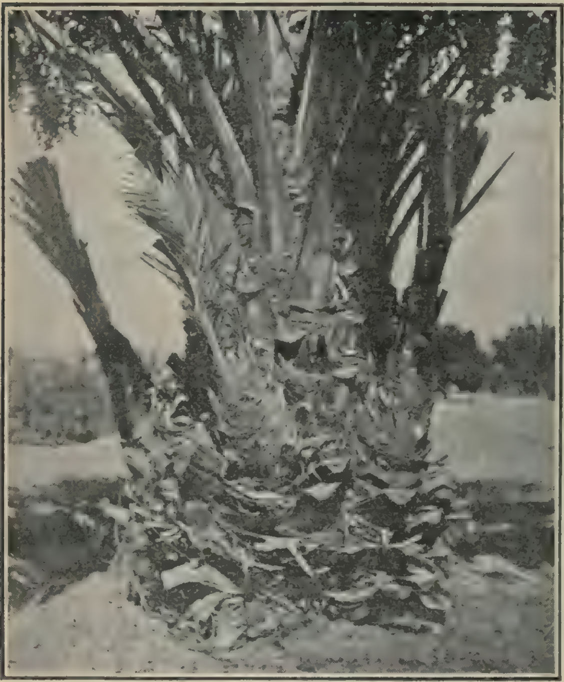

FIG. 1.—Date offshoots pruned, ready for removal from the parent palm.

The chisel used for the cutting should be made of the best tool steel with a cutting bit 5 inches wide by 7 inches long. One side should be perfectly flat, and the reverse should be beveled for 2 inches on the sides as well as on the cutting edge, so that on all sides the edge is thin and sharp. The beveled edges will guide the chisel when driving it behind the offshoot and eliminate all danger of cutting into the heart, which often extends very nearly to the point of union between the offshoot and the parent tree. The handle or driving bar of soft iron should be 2½ or 3 feet long, 1¼ inches in diameter, and welded to the bit with a split or wedge weld in order to withstand the heavy blows of the sledge hammer which is used in driving the chisel into the trunk of the parent tree when cutting the offshoot. A crowbar makes one of the best handles, as it does not split when being driven and is easy to weld. (Fig. 2.)

To cut the offshoot from the tree the flat side of the chisel should always face the offshoot to be cut. Set the chisel well to the side of the base of the offshoot close to the main trunk. Drive it in with a sledge until below the point of union with the parent trunk; then by manipulating the handle the chisel is easily loosened and cuts its way out. Next reverse and cut from the opposite side of the shoot until the two cuts come together. This operation will in most cases sever the offshoot from the trunk. No attempt to pry the offshoot from the tree should be made, as the tissues are so brittle that the terminal bud of the shoot may be ruined by checking or cracking. In cutting an offshoot directly at the base of a palm the soil should be dug away until the base of the offshoot is located and enough exposed to show the point of union with the mother plant. Then the chisel can be set without danger of cutting the roots of the parent tree so much as to injure or retard its growth. On such varieties as the Deglet Noor the connection of the offshoot is very small and there is no necessity for cutting deeply into the trunk to sever the offshoot from the tree.

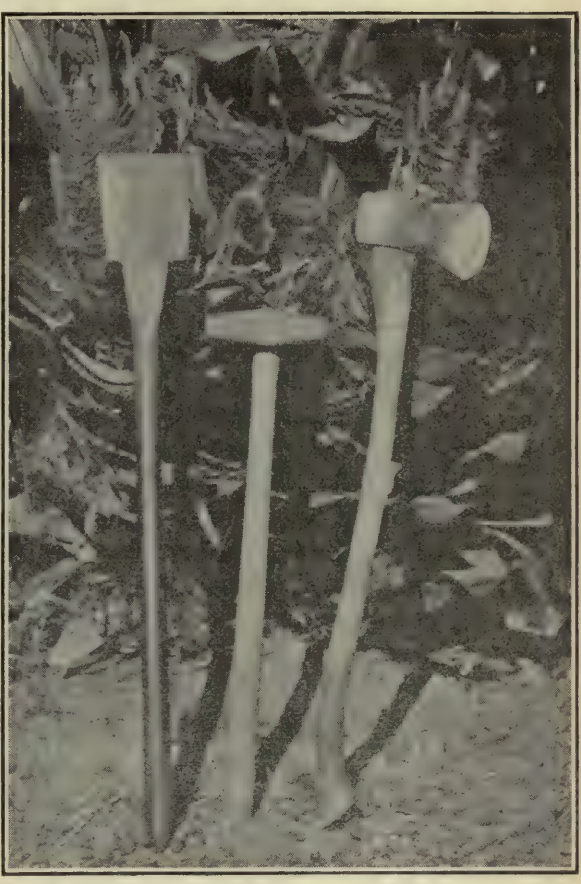

FIG. 2.—The proper tools for cutting date offshoots. The sledge illustrated weighs 8 pounds.

SEASONING OFFSHOOTS BEFORE PLANTING THEM IN PROPAGATING FRAMES.

Date offshoots when cut from the parent tree are usually in a moist, sappy condition that causes the tissue to ferment very rapidly if they are planted in the propagating frame immediately after cutting.

By a series of experiments extending over a number of years it has been found that with proper seasoning offshoots will root more rapidly and that the chances of loss by fermentation and fungous attack are much less than when the shoot is planted in a fresh condition. The length of time the offshoot should be seasoned depends on the size of the shoot, the time of cutting, and the position of the offshoot on the parent tree. Offshoots that are located at the base of trunks, which often have large spike roots, are very soft and tender when cut and will season more rapidly than shoots produced above the ground. Hence, while an offshoot weighing from 12 to 20 pounds at the base of the trunk should be seasoned at least 10 days, an offshoot of the same weight located on the trunk above the ground should be seasoned not less than 15 days before planting in the propagating frame, as the evaporation from the upper shoot is much slower than from the lower one.

A shoot at the base of the trunk weighing 15 pounds when cut and then seasoned for 10 days should weigh 13 pounds, a loss in weight of 13.5 per cent, due to the evaporation of part of the water in the tissues. On the other hand, a shoot that is cut above the ground, being hard and compact, at the end of 15 days will have lost only the same relative weight.[1]

Offshoots after being cut from the parent tree either should be left on the ground under the tree or set up in groups of 15 or 20 in a place in the open, where the air will circulate freely about them. They should not be watered until they are planted in the nursery bed. Offshoots ricked up like cordwood or covered with canvas have been known to ferment very rapidly. After the time of seasoning has elapsed the offshoots should be set immediately in the nursery bed.

SHED PROPAGATION OF DATE OFFSHOOTS.

With the average date grower the rooting of date offshoots in the field nursery has not been successful. The high percentage of loss in many instances has discouraged the grower at a time when success in rooting offshoots is the most important phase of this new and promising industry. It has been found that high temperatures combined with high humidity are the two essential factors in rooting offshoots. Hence, a shed frame has been developed which, if properly constructed, will furnish both heat and humidity, and this frame is coming into almost universal use for this purpose. (Fig. 3.)

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[1] Experiments made at the garden at Indio, Cal., to ascertain the total water content of small date offshoots (cut on March 2) gave the following results:

Variety.	Date.	Weight—						Percentage of loss.
		When cut.		When dry.		Loss.		
		Lbs.	*Oz.*	*Lbs.*	*Oz.*	*Lbs.*	*Oz.*	
Deglet Noor	Mar. 2	6	11	1	11	4	13	74
Maktum	...do...	12	7	2	9	9	14	79.3

CONSTRUCTION OF THE PROPAGATING FRAME.

The offshoot propagating frame is made on the same principle as the common coldframe for forcing small plants, but 12 by 20 feet in size or larger, with walls 6 feet high on the lower side and with a slope of the roof toward the sun of about 1 foot in 10 feet. It should be covered with 8-ounce or 10-ounce canvas instead of glass. It should be so constructed as to eliminate all air currents inside of the frame and keep the air as warm and moist as possible throughout the night.

To erect a shed of this kind 2 by 4 studding can be used for the frame, with 1 by 12 inch rough boards for inclosing it. The sides and ends are then covered on the outside with 1-ply or 2-ply roofing paper, with the lap cemented and nailed. The rafters to support the canvas are put across the frame every 3 feet. A strip of roofing paper 3 inches wide should be tacked on the rafter before the canvas cover is put on, as the vibration of the canvas in the wind when placed in direct contact with the rafter soon wears it through. These 3-inch strips of paper act as a cushion, and when so protected the canvas will last from 1 to 3 years. Battens half an inch thick by $1\frac{1}{2}$ inches wide should be nailed on each rafter over the canvas roof. The single one-tenth pitch roof has been found the most practical and should face the south or southeast, so as to receive the full sunlight for 6 hours of the day.

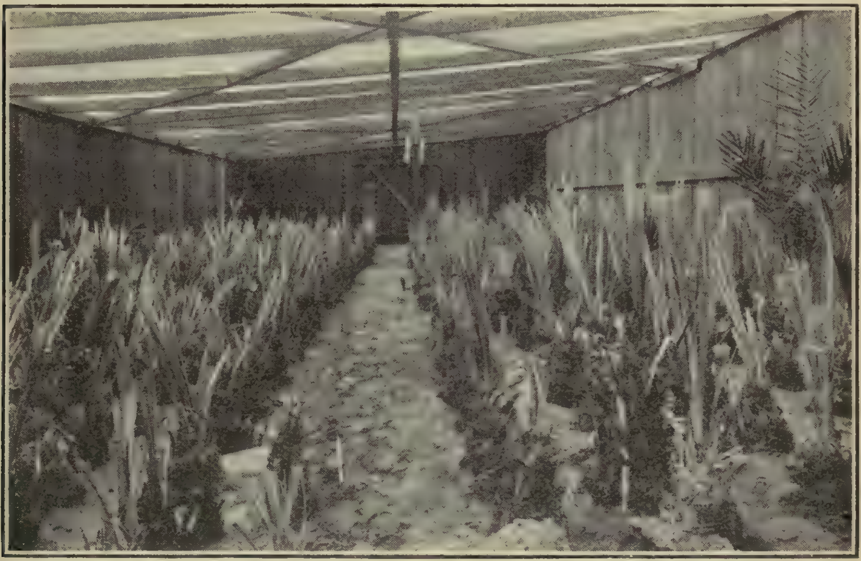

FIG. 3.—Interior view of a date-offshoot propagating frame at the Government Date Garden, Indio, Cal.

THE NURSERY BED.

A light sandy loam, well drained, should be used for the rooting of date offshoots. The amount of water that it is necessary to use on the shoots while rooting makes the character of the soil a matter of vital importance. From 8 to 12 inches of the surface soil should be excavated from the bed and replaced with good fresh stable manure well packed; then 2 inches of soil should be spread over the entire surface of the bed. The bed should then be flooded until the manure is thoroughly soaked. After four to six days, during which time considerable heat may be developed by the fermenting manure, the bed should be well flooded a second time. The offshoots can then be set in the nursery with safety.

DEPTH OF SETTING OFFSHOOTS IN THE NURSERY BED.

The depth of setting the date offshoot must be determined by its form and size, as some shoots have a long slim trunk, while others are very short with large bases. A depth of 8 inches has been found to cover practically all the rooting surface; consequently an offshoot weighing from 12 to 20 pounds can be planted safely at a depth of 8 inches. Where the unrooted offshoot is planted too deep there is danger of the crown or bud being flooded over when irrigating, which in hot weather generally proves fatal.

IRRIGATING OFFSHOOTS IN THE NURSERY BED.

From April 1 to October 1 the offshoots should be irrigated twice a week. During these months, when the maximum temperatures in the propagating frames are high, the humidity should be kept at the highest point possible. To effect this, there must be no drying out of the nursery bed. It should be borne in mind by the grower who contemplates the propagation of his offshoots that the value of a small nursery is so great that he can well afford to give it all the attention it requires; if he can not give it the necessary attention the offshoots should be sold or left on the trees.

During the late fall and winter months the bed can be irrigated once every 10 days. The furrow method or flooding can be used in irrigating the bed, but in either case the water should be shut off as soon as the moisture has penetrated the surface thoroughly. The writer prefers the method of flooding, as it takes only a few minutes to cover the bed, whereupon the water can be diverted without danger of getting the offshoots submerged. The bed should be level, so that the water will be distributed equally to all parts.

LENGTH OF TIME THE OFFSHOOTS SHOULD REMAIN IN THE NURSERY BED.

It is impossible to state the exact length of time that offshoots should remain in the nursery bed, but in no case should they be transplanted to the field until they are well rooted.

When the root system is sufficiently developed for removal, the offshoot should show from five to seven new leaves. As the leaves develop on the shoots in the nursery bed they usually appear in sets of three, and the second set should be starting to expand before the offshoot is transplanted to the field.

There is a wide variation in the time of starting and in the rapidity of growth of offshoots in the nursery; some will start new growth quickly, while others will linger and in some cases stay dormant for three or even four years and then begin to grow rapidly. The experienced date grower will look on such behavior on the part of the offshoot as natural and will apply only such stimulation as is necessary to revive it, while the inexperienced grower is likely to abandon such plants, which would represent a total loss. The methods here recommended for the propagation of offshoots, it is expected, will decrease the time of rooting and increase to a maximum the percentage of living shoots secured.

The loss of large numbers of offshoots in the Coachella Valley has been due to inexperienced or inefficient help. Growers can not afford the loss of valuable offshoots at this time, when so small a supply is available.

Causes leading to failure to grow a high percentage of offshoots may be summarized as follows: (1) Improper selection of the location for the nursery bed, (2) failure to construct the frame so nearly air-tight as to insure the necessary humidity and high temperature, (3) improper methods of cutting and pruning and the neglect of seasoning before planting in the nursery bed, and (4) the neglect of irrigation when necessary and the failure to apply water properly.

The points above mentioned are all essential to success, and to neglect one and observe the others may lead to as great a failure as to neglect them all.

TRANSPLANTING OFFSHOOTS TO PERMANENT POSITIONS.

The distance of spacing date offshoots in orchard or garden planting should be governed by the variety and the soil.

Experience with over a hundred varieties in the Coachella and Imperial Valleys in southern California shows that in medium sandy loam the best production of both fruit and offshoots is provided for when the palms are planted 30 feet apart. A few varieties, such as the Saidy, Thoory, and Tazizaoot, would give much better results if planted 35 to 38 feet apart.

The rooted offshoot when ready for transplanting should be pruned from three to five days before removing it from the frame. The new growth should be cut back to one-half the original height, leaving from three to five leaf stubs to support the expanded crown leaves. The holes in the field should be 3 feet in diameter and 3 feet in depth, with from 12 to 16 inches of stable manure placed in the bottom of each and 6 inches of soil on top and then irrigated thoroughly. The rooted palm when removed from the nursery should carry a ball of earth large enough to protect the small fibrous roots from exposure to the sun or dry winds. The average depth for planting should be 16 inches, but this may be varied somewhat with the size of the shoot. In any case the depth should be as great as possible without danger of covering the bud.

It is not advisable to transplant rooted offshoots later than June. April and May are considered the best months for transplanting either young or old date palms.

In southern California, where the dry winds occur from March until June, the transplanted palms should be irrigated thoroughly every week; in sandy soil two irrigations a week should be given until new, strong growth is established.

WINTER PROTECTION FOR YOUNG DATE PALMS.

Rooted offshoots when removed from the propagating frame are usually very tender and are very often slow in starting growth; hence, it is necessary to protect the trees during the following winter from freezing temperatures, which usually occur from December 1 to February 1.

Various methods have been used for frost protection, such as wrapping with canvas, burlap, and paper; of the three, paper has been used very successfully. During the winter of 1913, when the temperature dropped to 15° F. above zero, young date palms that were wrapped in canvas and burlap were killed, while those wrapped in paper were not injured.

Full sections of newspaper make good wrapping material for frost protection. The paper should be wrapped loosely around the young palm and tied loosely at the bottom and again in the center of the tree, leaving the top open. This cover can be left on the tree until April 1. In case the tree has made from 12 to 16 inches of growth while wrapped, the leaves should be pruned back 6 or 8 inches, as very often high winds break the leaf in the crown, causing injury which may be fatal to the young tree.

The leaves of the young palm may be frosted severely without injury to the bud, and in such cases as soon as the cold weather is over the frozen parts should be pruned back to the new tissue. Should the bud be killed by severe freezing the stump should not be destroyed at once, as offshoot buds will often develop rapidly around the base.

IRRIGATING THE DATE GARDEN.

On account of the extreme variation of soils in the date-growing regions of southern California, unusual care is necessary in selecting the proper method of irrigating a date garden. The roots of the date palm feed deeply, and it is necessary that the soil be kept thoroughly moist during the entire year.

THE BASIN METHOD OF IRRIGATION.

The basin method of irrigating date palms has been found very satisfactory, provided the basin is filled with straw or stable manure as a mulch. Basins should never be left exposed to the sun and dry winds without a covering of mulch, as the evaporation is very great and the moisture will have no chance to penetrate to the roots. The basin should be fully 15 feet square and 1 foot deep. This leaves a strip in the center between the rows that can be used for growing leguminous crops, such as alfalfa or sesban. Care should be taken that the basins are constructed so as to retain the water and give an equal distribution to each tree in the row. During the fall, when the dates are ripening, the basins can be filled with water every week, if necessary, to hasten the maturing of the fruit.

THE FURROW METHOD OF IRRIGATION.

In clean-cultivated soils, irrigating in furrows is perhaps the best method, running the water for 24 hours every 12 days from May 1 to November 1. Variations of the soil must be considered, however, as the writer has found that in many cases where water has been running for 36 hours it has penetrated to a depth of only 6 inches. Conditions of this kind may occur in light loam as well as in heavier soils. A thorough investigation after each irrigation should be made, in order to satisfy the grower that the moisture has reached the roots of the palms. As soon as possible after each irrigation by this method the orchard should be cultivated thoroughly, using a surface cultivator or a spring-tooth harrow to conserve the moisture, which would otherwise evaporate in 48 hours. For fruit and offshoot production proper irrigation is just as important as fertilizer, and without the two the commercial establishment of date culture can never be accomplished.

FERTILIZING THE DATE GARDEN.

The growth of the young palm after transplanting is very slow, and good care must be given the plant in order to induce a strong growth. On account of the very limited number of offshoots from choice varieties growing in the United States, the grower should realize that offshoot production by the mother palm is one of the most important factors in developing the date industry; therefore, in order to secure the very highest efficiency in production the mother plant should have a strength and vitality which can be obtained only by fertilizing the soil and by proper care and management.

In order to get the maximum production of offshoots it has been found that after the palm has been in the field for a year, growth should be accelerated by the use of frequent applications of fertilizer, such as stable manure, and by growing such cover crops as sesban, alfalfa, or wheat between the rows. Sesban, as a summer crop, produces an abundance of available nitrogen, while wheat can be grown for the straw, which gives when turned under a good bed of humus. In the desert soils of the Coachella and Imperial Valleys a hard layer of silt and sand is often found at a depth of 1 to 3 feet that is almost a hardpan. This is very difficult to penetrate with water, and naturally the palm roots are slow in penetrating this layer. Experiments with alfalfa planted in strips 15 feet wide between the rows have shown that its roots will break through this hard layer and allow thorough penetration by the palm roots.

The straw mulch should be turned under dry; green crops used in this way during the hot summer months ferment too rapidly. Where manure is available it should be applied to the date palm in the fall or winter. Two methods of application have been used successfully—in basins and in deep furrows.

The basin should be from 8 to 12 feet square and 1 foot in depth. The manure should be applied directly around the tree, and a little soil should then be thrown over the manure in order to make it compact and promote rapid decay. When applying manure by the furrow method a 12-inch breaking plow should be used, making a large open ditch 4 to 6 feet from the tree. The manure should then be thrown in the ditch on each side of the tree for a distance of 8 to 12 feet, and the breaking plow should again be used to fill up the ditch, leaving the last furrow open for immediate irrigation. It should be clearly borne in mind that whenever manure is applied in large quantities around the trees, irrigation should follow at once and at intervals of three days until they have had at least three successive irrigations.

Trees from 4 to 6 years old should have one-half cubic yard of manure each year until they cease to produce offshoots; after reaching this age 1 cubic yard can be applied, which with the help of cover crops should keep the tree in a condition to produce fruit each year.

Manure can usually be secured at from 80 cents to $1 per cubic yard; hence the cost per acre for this kind of fertilizer is $40 to $50. When available, gypsum may be applied with the manure to good advantage, as the action of the gypsum practically eliminates all danger of injurious heat from the manure.

If continuous crops of fruit of high quality are to be produced, the date palm must be well fertilized; otherwise, it will produce fruit only every other year and that of poor quality. (Fig. 4.)

SOILS SUITABLE FOR DATE GARDENS.

The date palm can be grown in a wide range of soils, from a heavy adobe to a light sandy loam. It will thrive under conditions showing slightly more alkali than is tolerated by such farm crops as alfalfa, wheat, or barley. With a soil that is too sandy it is difficult to maintain the proportion of humus necessary for the proper retention of moisture, and the fertilizing elements necessary to the production of commercial fruit crops are quickly leached away. These facts make it necessary to give this class of soils special attention in the

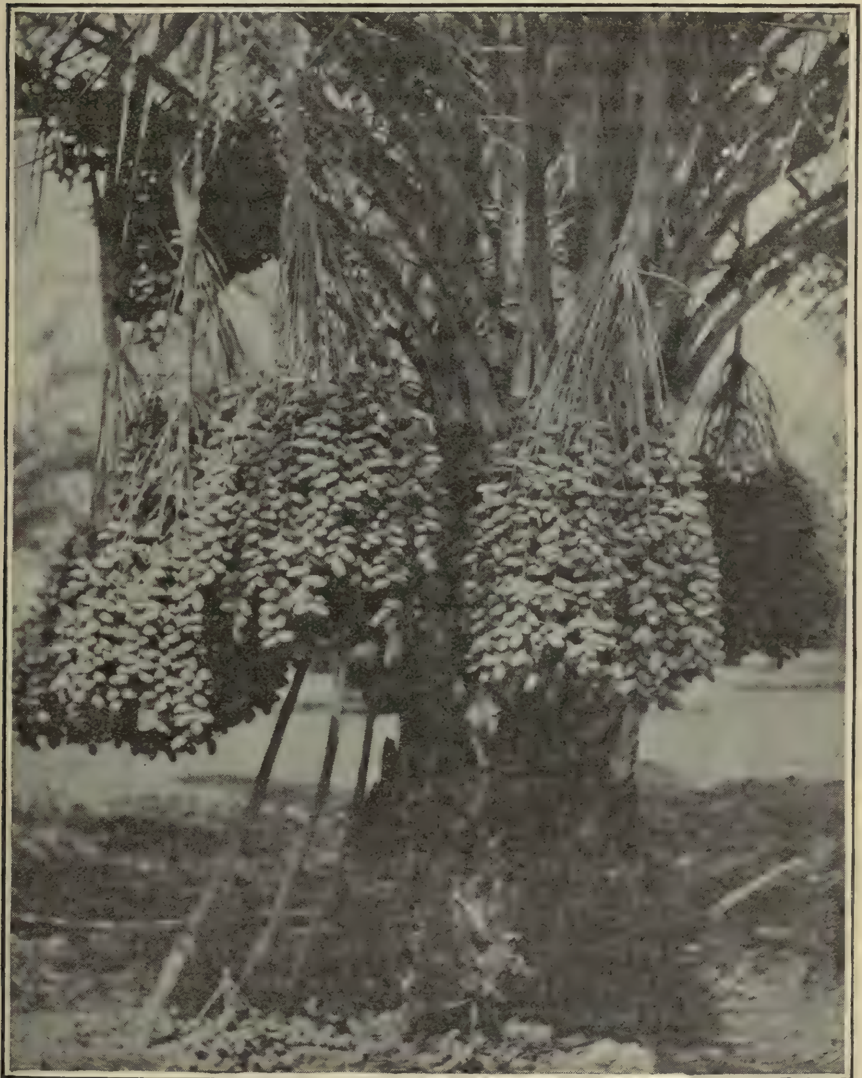

FIG. 4.—A 12-year-old date palm at the Government Date Garden, Indio, Cal., showing a heavy crop of fruit resulting from proper irrigation and fertilization.

application of stable manure or in growing and plowing under crops of nitrogen-fixing legumes.

With a heavy clay soil, on the other hand, much care must be taken to keep the soil in such a tilth as will secure the right penetration and distribution of water to the roots. Proper aeration and drainage must be carefully looked after in this class of soils. A rich well-drained sandy loam will give the best results, not only in the growth of the tree and offshoots but in the quantity and quality of fruit.

It is not advisable to plant dates in very light sandy soils unless the subsoil under the sand is heavy enough to support the palm after the root system has become established. Light shifting sand also injures the young fruit during the spring months, when high winds prevail. Such injury can be prevented to some extent by sowing rye or wheat among the palms in the fall or winter; but the cost of water and fertilizer should be considered very thoroughly by the grower before planting dates in such soils for commercial purposes.

CHOICE OF LOCATION OF DATE GARDENS.

While the mean temperature of a given section of country may be ample throughout the growing season for the maturing of a date crop, local conditions may prevail which will prevent the success of the more delicate varieties. The Deglet Noor, for example, is very sensitive to moisture, either as rain or dew, as the ripening process begins. In a section subject to rainfall in September or October or one where from lack of air drainage cool nights develop a dew point, it has been found that a large percentage of fruit of this variety is in some years lost by the development of a spot fungus, though the tree growth and setting of fruit may be all that could be desired. Other varieties, however, may be found on trial to succeed under such conditions.

The date palm requires a long growing season in summer with intense heat and a dry atmosphere. It should not be subjected to lower temperatures than 12° to 15° F. in winter.

The successful commercial culture of dates will probably be limited to such regions as the Salton Basin and the hot interior valleys of central California, the valley of the Colorado to the Nevada line, the lower Salt and Gila River valleys in Arizona, and possibly a small portion of the lower Rio Grande Valley in Texas. Such regions as the Gulf coast of Florida, the Gulf States generally, the Pacific coast southward from San Francisco, and parts of Texas are too humid to permit the fruit to ripen properly, though palms in those regions sometimes produce fruit of fair quality, suitable for home consumption in a fresh state.

PRUNING DATE PALMS.

The young palm should be pruned very lightly during the first three years. Unless some of the leaves are dry and dead there is no necessity for pruning until the palm is 4 years old in the garden; then two rows of leaves may be cut. At this age the young palm should be producing offshoots vigorously, and severe pruning would be fatal to the new offshoot buds. During the fifth year from one to three offshoots will be cut, and pruning of the leaves should be done only at the point where the shoot is severed from the trunk.

After the sixth year the palm should be pruned regularly each year in December or January. The leaves should not be pruned higher than the fruit stems of the former crop, which will leave about four rows of leaves below the new fruit stems, or approximately 30 to 36 expanded leaves. This number is ample to support the crop of fruit, while pruning up to the new fruit stems injures the fruit and may destroy the entire crop. (Fig. 5.)

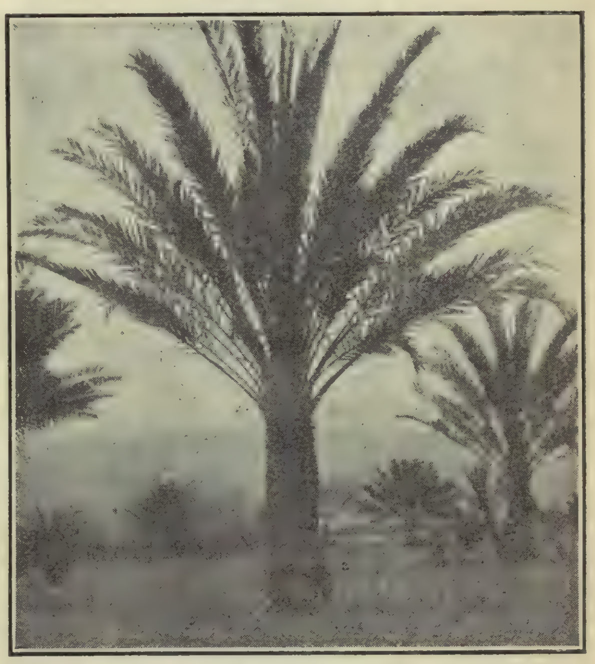

FIG. 5.—A date palm properly pruned.

FRUIT PRODUCTION IN RELATION TO OFFSHOOT PRODUCTION.

The general habit of the date palm when fruiting is to overproduce. This has been found to be a very serious handicap to offshoot production, for if a tree is allowed to produce large crops of fruit at an early age it will develop but few offshoot buds. The grower should realize that the value of a young palm of a desirable variety is not measured solely by the quantity of fruit it produces, but in a large degree by its ability to produce offshoots that will serve to increase his plantings. Under favorable conditions this increase should amount to tenfold every six years.

Four-year-old palms, if strong and vigorous, should be allowed to produce only two bunches. At the fifth or sixth year three or four bunches may be left, provided the palms have an abundance of water and fertilizer.

At all times the strength and vigor of the palm should be first considered by the grower in connection with fruit production, and it must be clearly understood that the future development of the date industry in the Southwest depends for the present on the production of offshoots instead of fruit.

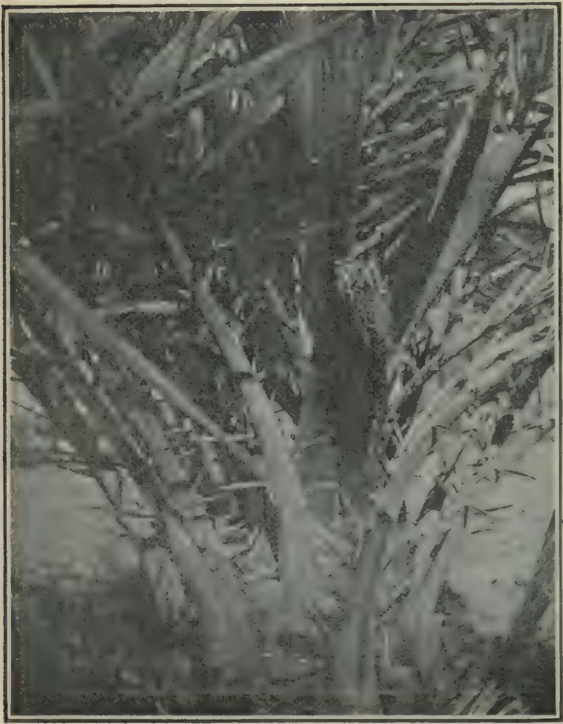
FIG. 6.—Flower clusters of the female date palm as they appear on the tree.

POLLINATION OF DATE PALMS.

For pollination the male is essential to the date grower. In order to get perfect mature fruit the pollen from the male flower must come in contact with the pistils of the female or fruit-bearing cluster. The female palm blossoms from February until June, although March and April are the months in which nearly all the spathes open. It is very important that the grower have male palms from which he can secure pollen during this period, as without them the entire crop will be a failure. The grower should, therefore, be careful in the selection of male trees. There is great variation among males, both in fertility and in time of blooming. Many male palms are sterile, while others bloom so irregularly that the grower can not depend on them to pollinate his crop. In the Coachella and Imperial Valleys, where large numbers of date palms have been grown from seed, the grower is usually very anxious to destroy all males as soon as they appear. This should not be done until he has made his selection for permanent planting.

In selecting male trees the first point to be considered should be the time of blooming, early flowers for use on early female blossoms being desirable. The next consideration should be abundance and fecundity of pollen, though the latter can be determined only by trial. These two points constitute the important characters to be secured in a permanent selection. A thoroughly tested male of proven high potency for use on any one of the standard fruiting varieties is a valuable asset and when obtained should be multiplied by rooting as many of the offshoots as are needed. Considering the fact that when the most careful selections have been made there are seasons when some of the male palms will be sterile, there should be at least two males for each acre of 50 bearing trees, so that the grower may always be sure of an ample supply of pollen for his garden.

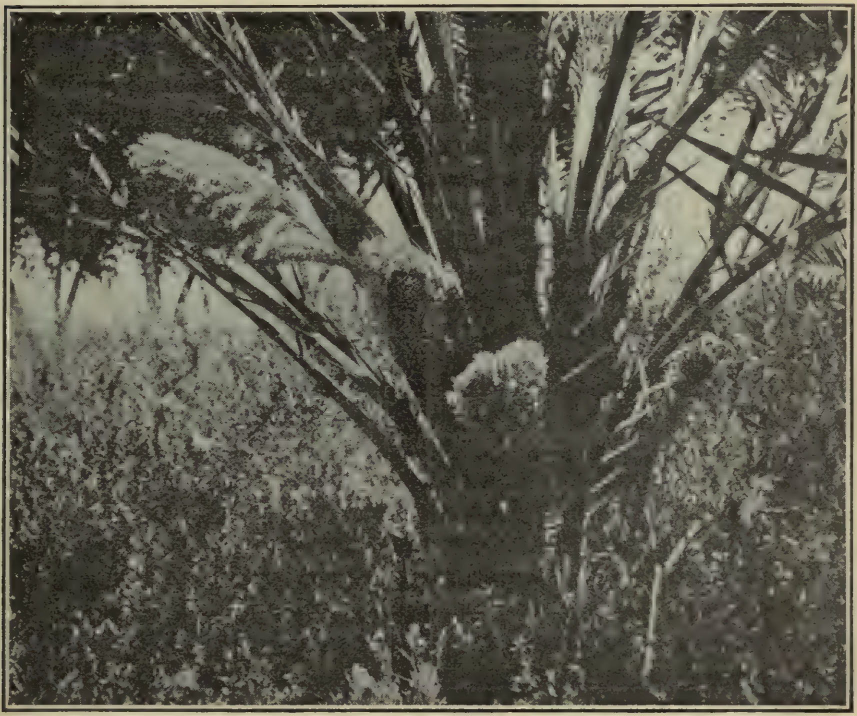

FIG. 7.—Flower clusters of the male date palm as they appear on the tree.

Male palms can be used for planting along driveways or as border rows around a garden, as nothing is gained by planting them among the female trees.

It is not advisable to pollinate the fruit clusters blooming later than May, though in seedling nurseries where the palms are being tested fruit clusters may be pollinated until the first of August. Very few, if any, of the dates are likely to mature from such late pollinations, but the size and color of the fruit can often be determined, which will be an aid in final selection.

While in a palm grove of unselected seedlings, with the trees of both sexes crowded together, the wind-blown pollen reaches many of the pistils, pollination in this way is unreliable.

To insure a setting of fruit it is necessary to pollinate artificially each fruit cluster by hand. Unpollinated dates are seedless and do not mature perfectly; hence, in order to secure dates of commercial value the pollination of the fruit cluster is always necessary. This is a very simple operation and can be done by anyone.

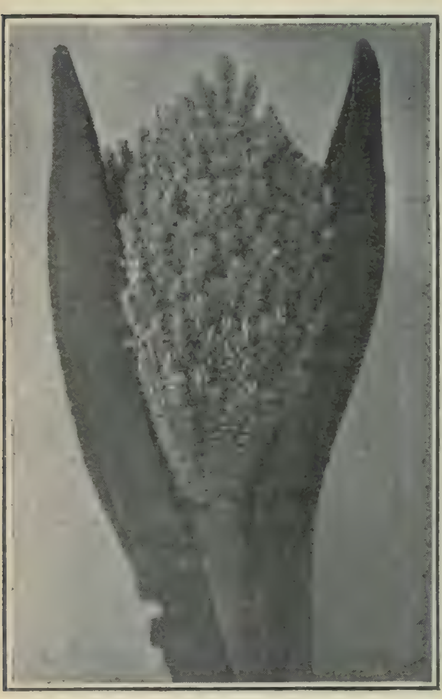

FIG. 8.—Flower cluster of a male date palm just emerged from the sheath and letting the pollen escape. (One-fifth natural size.)

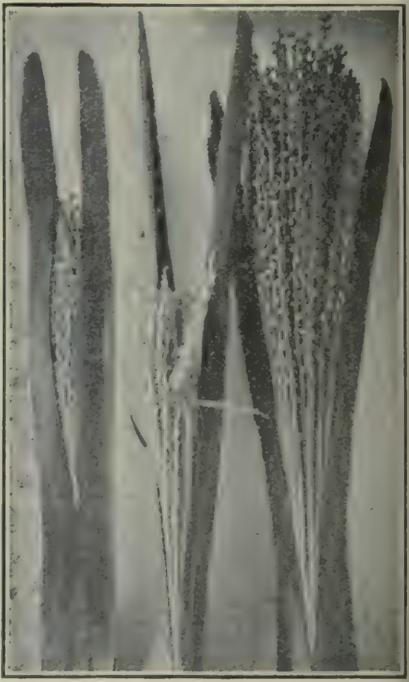

FIG. 9.—Female flower clusters: To left, just opening; in center, pollinated, showing male twig; to right, 10 days after pollination. (One-fifth natural size.)

In the first place, the grower should be able to recognize the difference between male and female blossoms. The writer has found in many seedling gardens male palms that were pollinated by new settlers who did not know the male from the female blossom. (Figs. 6, 7, 8, 9, and 10.) When the spathe opens on the male, it should be tested immediately to see if it contains pollen. By shaking the blossom gently, if fertile, the pollen will fall on the hand as an exceedingly fine yellow powder. The blossoms should be cut at once and put in a large paper bag to dry, and then stored in a room with the bag open. Mildew will destroy the pollen very quickly unless kept perfectly dry. Dry pollen can be kept and used for an indefinite period. The writer has used pollen that was kept in a bottle for ten years, securing a perfect setting of fruit. The date grower should always keep a good supply of dry pollen, as during some seasons both the male and female trees bloom irregularly. When using pollen that has been kept over from one season to the next, a small piece of cotton should be rolled in the pollen and inserted into the cluster, just as in using a sprig of the fresh flower cluster.

When possible, however, the grower should use fresh pollen. The sprigs can be clipped from the blossom into a tight box or basket and carried through the garden without loss of pollen. This makes the work of pollination very simple and convenient. One or two sprigs from the male blossom will be ample for each cluster of dates. If the spathe inclosing the female cluster is cracked and not entirely open, it should be opened and the pollen applied. The sprig from the male blossom should be turned with the open flowers downward, put at the top of the fruit cluster, and tied in place, using a small string or strip from the palm. One pollination for each cluster is all that is necessary unless a rain should follow within 24 hours after pollination, in which case the pollen should be applied again.

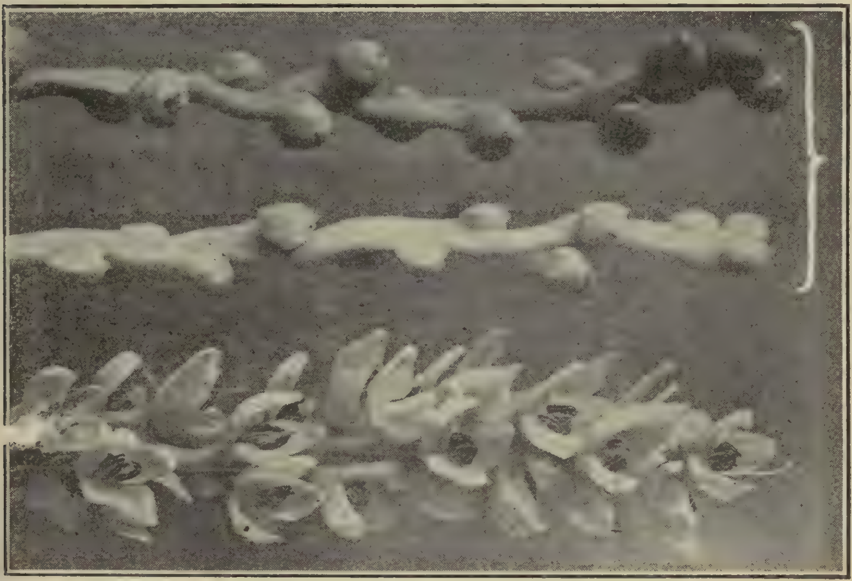

FIG. 10.—Female and male flowers of the date palm, magnified: Above, young fruits a week after pollination; in middle, female flowers ready to be pollinated; below, male flowers shedding pollen. (Three times natural size.)

Varieties differ in the length of time that may elapse between the opening of the female spathe and pollination. A series of experiments extending over a period of 15 days in the pollination of the Deglet Noor, Thoory, and Saidy varieties with the clusters bagged and three to five threads pollinated every 24 hours showed that pollinations up to the eleventh day gave 98 per cent of the fruit set on the Deglet Noor, 50 per cent on the Saidy, and about 25 per cent on the Thoory. No additional fruit set from pollinations later than eleven days. The safe method for the date grower will be to look over the garden every third day and pollinate the fruit clusters that are ready.

Pollen from ornamental palms should not be used by the grower for pollinating commercial dates. Palms of this type blossom very irregularly and only a small percentage of the blossoms contain pollen. The hybridizing of date palms and breeding by selection are projects still in the experimental stage and should be attempted at agricultural experiment stations only, where there will be no chance for untested seed from such pollinations to get into the hands of an unsuspecting grower who is starting a seedling date garden. The seedling date palm has an important place in the home fruit garden and has a distinct landscape value also, but it should not be depended upon where the production of dates in commercial quantities is the object of planting.

PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE RELATING TO DATE CULTURE, FOR SALE BY THE SUPERINTENDENT OF DOCUMENTS, GOVERNMENT PRINTING OFFICE, WASHINGTON, D. C.

The date palm and its culture. *In* Yearbook, Department of Agriculture, for 1900, pp. 453–490, 7 figs., 9 pls. 1901. Price, 75 cents.

Persian Gulf dates and their introduction into America. Bureau of Plant Industry Bulletin 54, 32 pp., 4 pls. 1903. Price, 10 cents.

The date palm and its utilization in the Southwestern States. Bureau of Plant Industry Bulletin 53, 155 pp., 10 figs., 22 pls. 1904. Price, 20 cents.

Date varieties and date culture in Tunis. Bureau of Plant Industry Bulletin 92, 112 pp., 52 figs., 10 pls. 1906. Price, 25 cents.

The present status of date culture in the Southwestern States. *In* Bureau of Plant Industry Circular 129, pp. 3–7. 1913. Price, 5 cents.

Botanical characters of the leaves of the date palm used in distinguishing cultivated varieties. Department Bulletin 223, 28 pp., 15 figs., 5 pls. 1915. Price, 10 cents.

Dates of Egypt and the Sudan. Department Bulletin 271, 40 pp., 9 figs., 16 pls. 1915. Price, 20 cents.

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UNITED STATES DEPARTMENT OF AGRICULTURE
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AGRICULTURE IS THE
FOUNDATION OF MANUFACTURE
AND COMMERCE

CATTLE SCAB
AND METHODS OF CONTROL AND ERADICATION

MARION IMES
Zoological Division

FARMERS' BULLETIN 1017
UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from the Bureau of Animal Industry
JOHN R. MOHLER, Chief

Washington, D. C. December, 1918

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CATTLE SCAB is a contagious skin disease affecting cattle of all classes, ages, and conditions. It is caused by minute parasites or mites, several species of which affect cattle. The nature and habits of the mites, the symptoms caused by each species, and methods of distinguishing the different kinds of cattle scab are described in this bulletin.

Scab is injurious to all classes of cattle, but the greatest injury occurs among bulls and old or weak animals of low vitality. Money losses are caused by irritation, shrinkage in weight, unthrifty condition, arrested growth, functional disturbances, low vitality, and increased death rate.

Cattle scab can be eradicated by dipping or spraying, but dipping is the better method of treatment. Lime-sulphur dips, nicotin dips, and crude-petroleum dips are efficacious. Methods of preparing and using these dips are described and the intervals between dippings and the conditions under which the various dips may safely be used for the different kinds of scab are discussed. Also, plans of cattle-dipping plants and directions for building vats and dipping cattle are given.

CATTLE SCAB AND METHODS OF CONTROL AND ERADICATION.

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VARIETIES AND GENERAL CHARACTERISTICS.

SCABIES IN CATTLE, commonly known as "scab," "mange," or "itch," is a name given to a group of contagious skin diseases caused by insectlike parasites known as "mites" which live on or in the skin. The four species of these parasites which affect cattle are classified zoologically in four different genera as follows: First, *Psoroptes;* second, *Sarcoptes;* third, *Chorioptes*, and fourth, *Demodex.*

In obtaining their food from the tissues of the host animal the mites cause wounds or lesions in the skin, and as each kind of mite possesses distinctive habits the nature and location of the lesions in the early stages are more or less characteristic. The psoroptic mites, which cause common scab, live in groups or colonies on the surface of the skin, and the lesions caused by them spread in all directions from the spot first affected. The sarcoptic mites burrow into the skin, each female making a separate gallery in which she lays her eggs. The chorioptic mites live in groups on the surface of the skin but usually remain localized on the limbs or tail with little or no tendency toward spreading. The demodectic mites, which are much smaller than the other mites under discussion, being truly microscopic in size and in appearance more like worms than typical mites, live in the hair follicles and sebaceous glands, the evident lesions consisting of small spherical swellings or pustules in the skin.

PSOROPTIC OR COMMON SCAB.

Psoroptic or common scab occurs in cattle much more frequently than any of the other varieties, and although not so dangerous a disease as sarcoptic scab, because of its greater prevalence it causes larger losses to the cattle industry than the latter. In the western part of the United States, especially where cattle graze on the open ranges, the losses caused by common scab have been a serious drawback to the industry, but through the cooperative work of the Bureau of Animal Industry and the officials of the States concerned the disease has been greatly reduced and brought under control in those areas where formerly it occurred very frequently. It has not, however, been entirely eradicated from the herds of the Western States, and it is important to eradicate the disease completely in order to prevent it from again becoming prevalent. In the farming communities common scab occasionally is found on cattle in various sections of the country, where, unless properly treated, it causes great losses.

When allowed to spread common scab becomes a serious disease affecting cattle of all ages, classes, and conditions. The losses are caused by shrinkage in weight, failure of young stock to thrive and gain weight normally, and by an increase in the death rate of poorly nourished animals of low vitality, especially range cattle exposed to inclement weather.

THE PARASITE WHICH CAUSES COMMON SCAB.

The mites which cause common cattle scab are small, white, or yellowish-colored parasites known technically as *Psoroptes equi bovis* or more often as *Psoroptes communis bovis* (fig. 1). The female when full grown measures about one-fortieth and the male about one-fiftieth of an inch in length. They are visible to the naked eye, especially when they are placed on a dark background. The general form of the body is oval or egg-shaped and the tapering head is longer than broad. These mites when mature nave four pairs of legs, all of which extend beyond the margin of the body.

The entire life cycle is passed on the body of the host animal. Each female may deposit from 15 to 24 eggs, which hatch after 3 or 4 days' incubation. The young mites reach maturity, mate, and the females deposit eggs in from 10 to 12 days. These stages in the life history have an important bearing on the interval which should elapse between treatments.

Dipping if properly done will kill all the mites but can not be depended upon to destroy all the eggs. Some of the eggs will survive dipping and they may hatch after the first dipping, forming a new generation of mites. To complete the treatment this new generation should be destroyed by a second dipping before they have had time to develop and deposit eggs.

As the period of incubation on the host is from 4 to 7 days and probably never exceeds 10 days, and as the young mites do not begin depositing eggs until they are 10 or 12 days old, it is evident that the interval between the first and second dippings should be from 10 to 12 days. Practical experience has shown that the interval between dippings may be extended safely to a maximum of 14 days; however, the 10 to 12 days' rule should be followed whenever possible.

SYMPTOMS OF COMMON SCAB.

The mite which causes common cattle scab may attack any part of the body covered thickly with hair, but the first lesions usually occur on the withers, on top of the neck just in front of the withers, or around the root of the tail. From these points it spreads over the back and sides and unless checked it may involve practically the entire body.

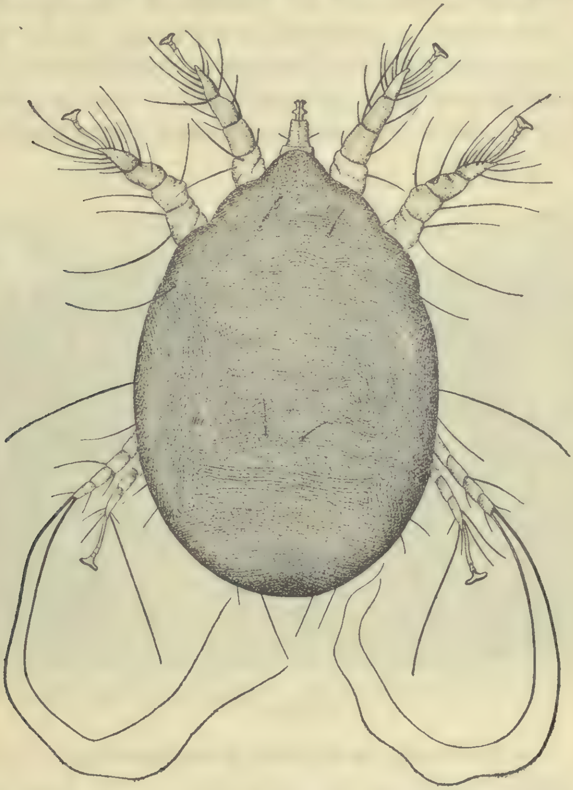

FIG. 1.—Psoroptic scab mite. Female. Magnified 100 times.

When a scab mite finds lodgment on the body it pricks the skin to obtain food and in so doing probably introduces a poisonous secretion into the wound. A slight inflammation is caused, but this early stage of the disease is rarely, if ever, detected by casual observation. As the mites multiply, large numbers of small wounds are made in the skin and are followed by intense itching, formation of papules, inflammation, and exudation of serum. The serum which oozes to the surface becomes mixed with particles of dirt and more or less infected with microorganisms. This mass soon hardens into yellowish or gray-colored scabs which frequently are stained with blood. In the early stages of the disease the scab may be about the size of a pea, but as the mites seek the healthy skin around the edges of the wound the scab or lesion gradually increases in size.

Some of the mites migrate to other parts of the body and start new lesions, which extend until they cover large areas (fig. 2). As the disease advances increasingly large areas become denuded of hair and covered with thick, adherent crusts or scabs. The skin becomes tumefied, corrugated, and greatly thickened (fig. 3). The itching is severe and the animal is constantly irritated. In its efforts to relieve the itching and irritation the animal spends so much time licking, rubbing, and scratching that it has very little time for grazing. Consequently it loses flesh, becomes weak and emaciated, and unless relieved finally succumbs.

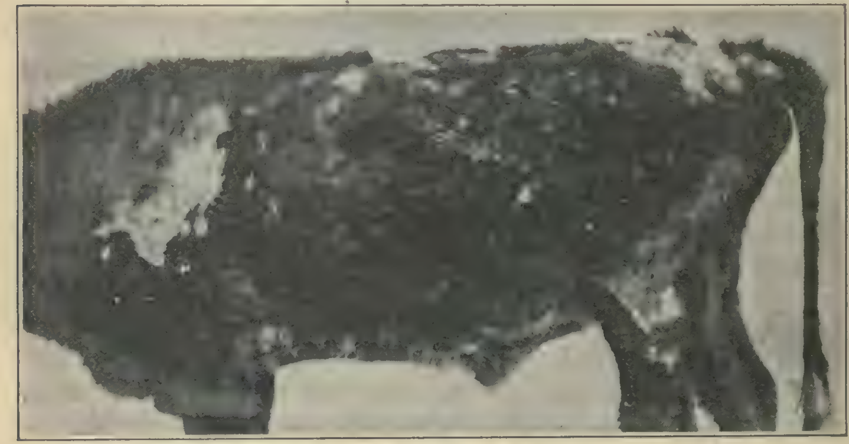

FIG. 2.—A well-developed case of common scab. A steer can not thrive while suffering from this disease.

DETECTING SCAB IN ITS EARLY STAGES.

The most certain diagnosis consists in demonstrating the parasite which causes the disease. This may be done by scraping the outer edges of the infected areas with a blunt-edged knife and transferring the scrapings to a smooth, black surface, such as a piece of black paper. Spreading the scrapings in the warm sun or near artificial heat usually causes the mites to become active and they can be seen as minute, gray, moving bodies against the dark background. They are quite plainly visible under a low-power hand lens. By parting the hair of infected animals and removing the small scabs the mites can sometimes be seen on the underlying moist, red skin and removed upon the point of a knife blade for examination. When the mites are causing active irritation the surface of the skin around the edges of the lesion or under the small scabs is red and moist and under such conditions the parasites usually are present in large numbers. On the other hand, if the lesions and surrounding skin are dry and dull in appearance, it indicates that the mites are inactive at that point and that they will be difficult to find.

Persistent licking, rubbing, or scratching is the first indication of scabies as well as of lousiness [1] and various other conditions, but if it is remembered that scabies is caused only by scab mites the diagnosis is rendered more simple. Although the hair conceals the small scabs in the early stages of the disease, its disarranged condition over the lesion indicates the area which should be closely examined. By manipulating such areas with the hand the dried serum or scabs may be found and removed for examination, and search made for mites. The areas of skin affected by scab become thickened and hardened. This condition may be detected readily by pinching up a portion and comparing it with the surrounding healthy skin. Other conditions resembling scab rarely if ever cause this characteristic, uniform thickening of the skin.

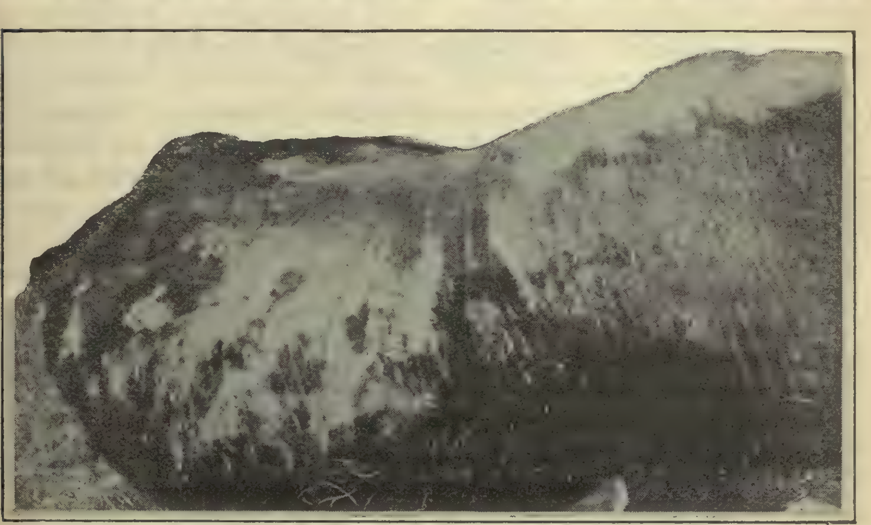

Fig. 3.—A case of common scab, showing characteristic wrinkles on neck and shoulder.

Well-advanced cases of scab usually are easy to diagnose, but the disease should never be allowed to reach this stage, because in the early stages it yields readily to proper treatment, and if allowed to spread it entails heavy losses.

CONTAGIOUSNESS OF COMMON SCAB.

Each species of domesticated animal has its own peculiar variety of psoroptic scab, and common cattle scab is not transmissible to other species of animals. It is, however, contagious to all classes of cattle and is transmitted by direct contact with animals or objects that are carriers of the mites. The disease spreads much more rapidly among closely confined cattle than among those on the open range or in large pastures. Although the disease develops much more rapidly and is more severe in its effects on old, weak, or poorly nourished animals of low vitality, nevertheless feed-lot animals in full vigor often become infected to such extent that they do not thrive or gain weight normally even when on full feed. Bulls, old cows, and unthrifty cattle usually are the first members of the herd to contract the disease, and during the winter season the contagion spreads rapidly from them to other cattle with which they come in contact. Visible lesions of scab may develop in from 15 to 45 days after exposure, or a much longer time may elapse before the exposed animals show indications of infection.

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[1] See Farmers' Bulletin 909, "Cattle Lice and How to Eradicate Them."

The transmissibility of the disease to a herd is not limited to any one season of the year, although cattle in a thriving condition on green, succulent feed seldom contract scab. In fact, in the spring, when infected cattle are turned out on green grass and the old coat of hair is shed, the disease often assumes the appearance of having been cured; usually, however, it will break out again with the coming of cold, stormy weather.

One or more attacks of the disease do not confer immunity, and after cattle have been treated and the disease cured they may become reinfected by contact with infected animals or by confinement in inclosures in which infected cattle recently have been kept. Though the most important factor in spreading scab mites is the infected animal, the possibility of cattle becoming infected from infectious premises should not be overlooked. Although the mite will not propagate itself except on the bodies of cattle, it is able to live for 2 or 3 weeks when removed from cattle, and under favorable conditions may live much longer. Dislodged eggs which drop in moist, protected places may retain their vitality for from 2 to 4 weeks during mild weather. In dry places exposed to bright sunlight the mites and eggs are destroyed in a few days. Owing to the varying conditions which may affect the longevity of the mites and the viability of their eggs when separated from their host, it is impossible to state definitely how long infection persists in infected inclosures after removal of the cattle.

It is advisable, therefore, to clean and disinfect all infected sheds, barns, yards, or small inclosures before using them for clean or dipped cattle. Remove all litter and manure, cleaning down to a smooth surface, then spray all walls, woodwork, and floors with a good disinfectant. The coal-tar-creosote dips and disinfectants diluted in accordance with instructions on the container are suitable for this purpose. All litter and manure from infected premises should be spread on the ground and plowed under or disposed of in such manner that cattle can not come in contact with it, and all equipment such as currycombs, brushes, blankets, etc., used on or around infected animals, should be immersed in the disinfectant. An economical and effective method of disinfecting stone or wire-fence corrals is to scatter straw or similar material on the surface of the ground and burn it. If the material is dry enough to burn readily, sufficient heat will be produced to destroy the infection.

TREATMENT OF COMMON SCAB.

The only rational treatment for scabies consists in using some external application which will kill the parasites without injuring the animals. Internal remedies, such as sulphur and salt and various other preparations, have not proved to be effective in practice and they should not be depended upon. Cases of common cattle scab are easily cured if proper treatment is applied before the disease becomes advanced.

The dips commonly used and permitted by the Bureau of Animal Industry for use in official dippings of cattle for scabies are lime-sulphur and nicotin solutions. Two dippings, from 10 to 14 days apart, in one of these dips can usually be depended upon to cure cases of common scab.

SARCOPTIC SCAB.

DISTRIBUTION AND ECONOMIC IMPORTANCE.

Sarcoptic scab or mange, commonly known in some regions as "barn itch," is found more or less frequently on both farm and range cattle throughout the country. Though it has not become prevalent in any one section, it seems to be increasing among farm cattle east of the Missouri River as well as among cattle on the ranges of the West, especially in the southwestern part of the United States. The disease sometimes develops in pure-bred cattle, and animals shipped from herds of that kind may carry the infection although they may not show visible symptoms of scab at the time they are shipped. Pure-bred bulls of the beef breeds seem to be especially susceptible and they are an important factor in spreading the disease.

Owing to its comparative rarity sarcoptic scab in cattle had not been considered of much importance in the United States but during the last few years the disease has been on the increase and it has become a factor to be reckoned with. The disease is more serious than common scab because it is more severe in its effects and more difficult to eradicate. When introduced into a herd the infection may persist for years and cause very great losses unless proper methods of treatment and sanitation are adopted. The losses are caused by irritation, unthrifty condition, arrested growth, decreased vitality, functional disturbances, and increased death rate. The breeder of pure-bred cattle who supplies bulls for grading up range and farm herds finds his business very nearly ruined when sarcoptic scabies develops in his herd. In dairy herds it may affect milk production seriously and throw the balance on the wrong side of the ledger. The disease, however, can be eradicated, and if proper methods are adopted before it becomes advanced the losses can be reduced to a minimum.

THE SARCOPTIC SCAB MITE.

The parasites which cause sarcoptic scab are known technically as *Sarcoptes scabiei bovis* (fig. 4), and they resemble in a general way the common scab mites. They are slightly smaller than the latter, the mature female measuring about one-fiftieth and the male about one-sixtieth of an inch in length. The general form of the body is more nearly round than oval and the bluntly rounded head is as broad as it is long. When mature these mites have four pairs of short, thick legs, the fourth pair and usually the third pair not extending beyond the margin of the body. A conspicuous feature under a high-power microscope is the presence of a number of short, backward-projecting spines on the upper surface of the body of the mite.

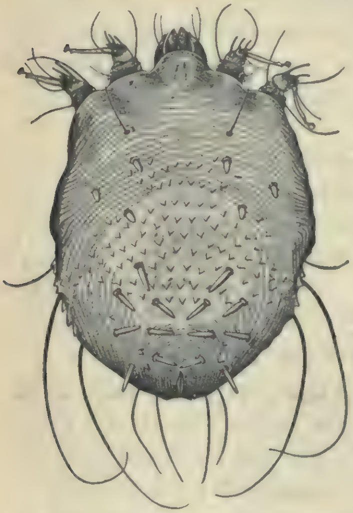
Fig. 4.—Sarcoptic scab mite. Female. Magnified 100 times.

As in the case of the common scab mite, the entire life cycle of the sarcoptic mite is passed on the body of the host animal. The sarcoptic mites, however, do not remain on the surface but penetrate through the upper layer of the skin and excavate burrows or galleries in which the mating of the sexes occurs and the eggs are laid. Each female may lay from 10 to 25 eggs during the egg-laying period, which probably lasts from 12 to 15 days. When the egg-laying period is completed the female dies in her burrow. The eggs hatch in from 3 to 10 days and the young mites after passing through several molts reach maturity and begin laying eggs in 10 or 12 days. As the surface of the skin constantly is wearing away and being renewed from below, the young mites are close to the surface when they hatch out. They can escape easily from their shallow burrows, and it is probable that at least a part of their life before egg laying begins is spent on or near the surface. The young mites form new burrows in which they deposit their eggs.

As the average period of incubation on the animal is about 4 days and the average period after hatching until egg laying begins is about 11 days, a new generation of mature mites may be produced by each fertile female in about 15 days. As the commonly used dips, however, will not always penetrate to the bottom of all burrows and kill all the mites at one application, the interval between dippings can not be calculated so accurately for sarcoptic mites as for psoroptic mites. Practical experience has shown, however, that when two or more dippings are given the interval between dippings should be from 6 to 10 days.

SYMPTOMS OF SARCOPTIC SCAB.

The mites which cause sarcoptic scab in cattle prefer locations where the skin is tender and the hair is thin. In the early stages of the disease the lesions usually are found on the inner surfaces of the thighs (fig. 5), the underside of the neck or brisket, or around the root of the tail. From these parts the disease extends until the entire surface of the body may become involved. The parasites burrow into the skin, each one making a separate gallery, and the skin over each burrow becomes inflamed and swollen. These swollen areas or papillæ are somewhat larger than pinheads and often have a yellowish-colored granule of dried serum adhering to them. As the mites multiply the diseased area increases and the granular, conical papillæ or raised areas become closer together. The hair over the affected part stands erect and some of it drops out or is rubbed off, though usually a few scattering hairs remain even in advanced cases. In some cases the affected areas of skin take on a dry, scurfy, or leatherlike appearance, especially when the mites are not very active.

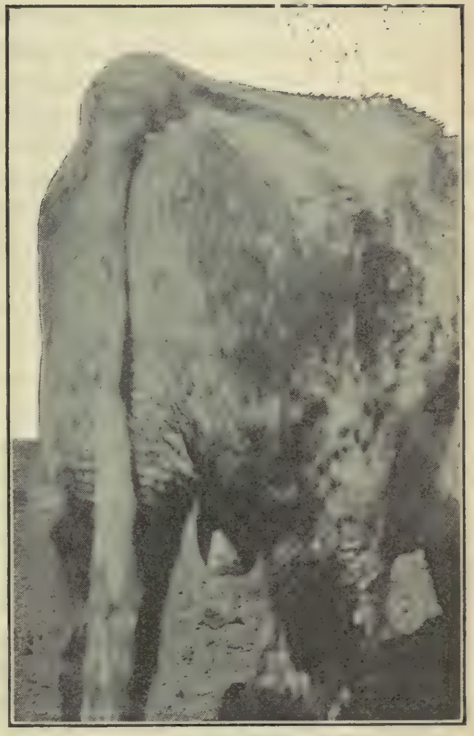

FIG. 5.—A case of sarcoptic scab, showing characteristic appearance of skin on inside of left hind leg.

To relieve the intense itching the animal licks, scratches, and rubs the affected parts until the skin becomes raw. The mechanical injury thus caused results in a running together of the small granular areas, and large scabs are formed. When the disease reaches this stage it resembles common scab and can be differentiated from it only by identifying the mite.

As the disease advances the skin becomes more or less bare and is greatly thickened and thrown into wrinkles or folds. The furrows caused by the wrinkles are thickly inhabited by mites, and scrapings taken from the bottom of a fold usually contain the parasites in abundance. In severe cases the animals lose flesh, become emaciated and greatly weakened, and unless properly treated many of them will die.

Typical cases of sarcoptic scab in the early stages may be distinguished from common scab by the location and character of the lesions and the manner of spreading, but usually it is difficult to differentiate between the two diseases without first identifying the mites.

For practical purposes in the field, where facilities for examination are limited, the principal differences in form and structure of the two species of mites may be summarized thus: The sarcoptic mite is slightly smaller than the common scab mite and the body of the former is more nearly round than oval, while in the latter it is egg-shaped or oval. Adults of both species have four pairs of legs, those of the psoroptic mites being long, and all four pairs extend beyond the margin of the body. The sarcoptic mites have shorter legs and the fourth or hind pair and usually the third pair do not extend beyond the margin of the body. The head of the common scab mite is tapering or cone-shaped and is longer than it is broad, while that of the sarcoptic variety is bluntly rounded in front and is as broad as long.

It is advisable to examine several specimens in all cases because the females of the two species are more easily distinguished from one another under low-power magnifying glasses than the males. On account of the burrowing habits of the sarcoptic mites they are difficult to find, especially in the early stages of the disease. They are situated in the burrows under the conical papillæ and by scraping the infected area until blood oozes from the tissues the mites sometimes may be found in the scrapings.

When cattle are dipped twice for common scab and the disease persists regardless of such treatment, it is advisable to apply treatment for sarcoptic scab.

CONTAGIOUSNESS OF SARCOPTIC SCAB.

Sarcoptic scab is transmissible from one species of animal to another and also from animals to man. Ordinarily when one species of animal contracts the contagion from another species the mites live only a limited time on the newly affected animal. Sarcoptic mites of the horse, sheep, goat, and cat may live on cattle, while those of the horse, dog, and hog are known to be readily transmissible to man.

Sarcoptic scab of cattle is contagious to all classes of cattle and is transmitted by direct contact with animals or objects that are carriers of the mites. While apparently the disease spreads more slowly than common scab, especially among cattle not closely confined, it makes great headway in herds crowded in yards or stables where the animals come in close contact. In range herds the bulls and old cows are most susceptible to the disease, and the contagion spreads slowly during mild weather. With the advent of cold, stormy weather, however, the contagion may spread throughout the entire herd. The disease develops rapidly under various insanitary conditions, such as crowded or unclean quarters, exposure to cold, inclement weather, insufficient feed of poor quality, or any other circumstance tending to lessen the vitality or functional activities of the animal. When the mites are active the lesions extend rapidly and the entire surface of the animal's body may become involved in 6 weeks.

While the contagion usually is spread by direct contact with infected animals, it also may be contracted from stables or small inclosures in which mangy cattle recently have been confined, or from currycombs, brushes, blankets, mangers, etc. Although the mites do not propagate themselves except on the bodies of animals, the mites as well as their eggs may retain their vitality for a considerable time after they are removed from the body. When exposed to sunlight in dry places the sarcoptic mites live only a few days, but in moist, protected places they may live 3 weeks or even longer. It is evident therefore that all stables and small inclosures occupied by mangy cattle, and all implements and coverings, such as currycombs, brushes, blankets, etc., should be cleaned and disinfected before they are used for clean or dipped cattle. The cleaning and disinfecting for sarcoptic scab should be done in the same manner as for common scab.

TREATMENT FOR SARCOPTIC SCAB.

Sarcoptic mites, probably on account of their burrowing habits, are much more difficult to eradicate than the common scab mites. The dips recommended for common scab will kill sarcoptic mites if the liquid comes in contact with them, but these dips may not reach all the mites at one application. Persistent, thorough, and frequent application of the common dips, however, will effect a cure, especially if all infected parts are scrubbed well with a brush and soaked with dipping solution just prior to the first dipping.

Experience has shown that 4 dippings in either a lime-sulphur or a nicotin dip will cure sarcoptic scab in cattle. The interval between dippings should be from 6 to 10 days. When properly used these dips are not injurious, and cattle may be dipped in them any number of times without other losses than those caused by shrinkage and accidents.

One dipping in crude petroleum usually cures sarcoptic scab, as it seems to destroy the eggs as well as the mites. One of the greatest drawbacks to the use of crude petroleum as a dip is that in some cases it is injurious to the animals.

CHORIOPTIC OR SYMBIOTIC SCAB (TAIL MANGE).

Chorioptic or symbiotic scab, or tail mange, occurs occasionally in cattle but is of less importance than either of the two varieties already described. It is caused by a mite known technically as *Chorioptes bovis bovis*, which under a low-power magnifying glass closely resembles the common scab mite. Though it usually spreads very slowly, the disease is contagious to all classes of cattle. It is not transmissible from one species of animal to another. The mites live on the surface of the skin and produce lesions resembling those of common scab. The lesions usually are found on the tail or limbs and generally remain localized, with little or no tendency toward spreading. For practical purposes it is not necessary to differentiate between chorioptic and common scab because the treatment recommended for common scab will cure the former.

DEMODECTIC (FOLLICULAR) MANGE.

The true nature of demodectic mange, also known as follicular mange, is not often recognized in cattle. The lesions that characterize it are very different from those seen in the other varieties of mange or scab, and the disease usually progresses very slowly. It is said by some observers that generally the lesions appear first on the shoulders and neck in the form of small spherical lumps in the skin, ranging in size from that of a millet seed to that of a pea or larger. These lumps increase in number in progressive cases until in the last stages of the disease they may be present nearly everywhere in the skin, or in some cases there is very little alteration in the size and number of the nodules during a period of 2 or 3 years. The contents of the nodules may be a rather firm kernel, creamy white, of cheesy consistence, or finally the nodules may burst and discharge a creamy, purulent material. Under a high-power microscope numerous small wormlike mites are visible in the material squeezed out of the nodules. To obtain material for examination it may be necessary to cut into the swelling before the contents can be squeezed out.

These parasites are known as *Demodex folliculorum bovis*. Similar follicle mites occur also in dogs, horses, human beings, and in other animals. As in dogs, follicular mange in cattle may be considered as practically incurable, although its progress may be delayed by regular dipping. Cattle in advanced stages of the disease should be killed, mild cases should be segregated and dipped frequently, and the rest of the herd dipped at least once as a precautionary measure. The swellings on the backs of cattle, caused by the presence of the fly larvæ commonly known as warbles, with which most cattle owners are familiar, should not be mistaken for follicular mange.

METHODS OF APPLYING TREATMENT.

Dipping and spraying are the two methods of treatment commonly used for cattle scab. Dipping, which consists in immersing animals in a medicated liquid that will kill the parasites, is the only method recognized by the Bureau of Animal Industry in the official treatment of scabby cattle. It is the most practical and effective known method, because in the dipping vat the entire surface of the animal's body receives a thorough wetting. Dipping plants are usually arranged so that the cattle enter one end of a vat filled with dip through which they swim and leave the vat at the opposite end (fig. 6).

Spraying is not so economical or effective as dipping, because of the difficulty of thoroughly wetting the hair and skin of cattle with a spray. Much of the dip runs off and is wasted, and unless plenty of it is used and the spraying is continued until all parts are well soaked the treatment will not be effective. Cattle scab can be cured by spraying, however, if the work is done properly. This method is recommended only when the number of cattle is not large enough to justify the owner in providing a dipping vat and no vats are available in the neighborhood. An ordinary hand spray pump (fig. 7) can be purchased for less than $10, or if an orchard-spraying outfit is available it may be used for spraying cattle. Any of the dips recommended for scab may be applied in the form of a spray, and the interval between sprayings should be the same as those between dippings.

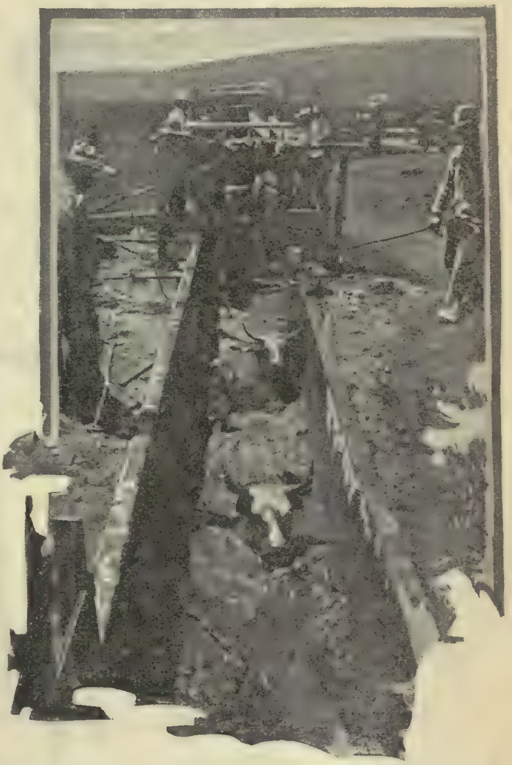

FIG. 6.—Dipping cattle in cement vat. Two dippings, 10 or 12 days apart, may be expected to free a herd from the mites that cause scab.

All animals in the herd should be treated, regardless of the number showing lesions of scab. One dipping, however, generally is sufficient for cattle not visibly diseased; in other words it is sufficient for cattle that have been exposed to infection but among which the disease has not yet become apparent.

DIRECTIONS FOR DIPPING.

If dipping is to be successful it is necessary to give close attention to details and see that the work is performed carefully and thoroughly. Before cattle are brought to the vat they should be watered and fed, so as not to be hungry or thirsty at the time of dipping; on the other hand, when dipped they should not be gorged with feed and water. If they are watered and fed from 2 to 4 hours before dipping, they are likely to be in the best condition for the operation. When cattle have been driven and are hot at the time of reaching the vat they should be allowed to cool off before they are dipped, as it is dangerous to dip them while they are overheated. When the nights are cold dipping should be finished for the day early enough for the animals to become dry before sunset.

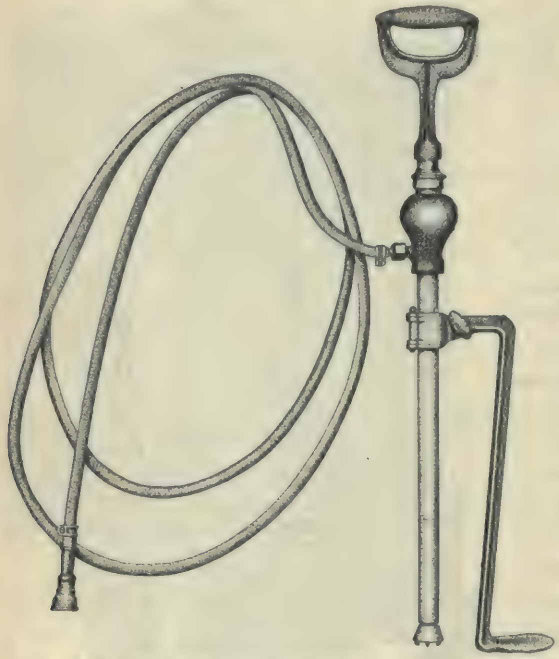

FIG. 7.—Small spray pump suitable for spraying cattle.

The dip in the vat should be maintained during dipping at a depth of 70 or 80 inches, or a depth sufficient to swim the tallest animal to be dipped. The quantity of dip necessary to obtain that depth should be ascertained before it is prepared. The average 1,000-pound, short haired steer will carry out and retain about 2 quarts of dip, and a long-haired one of the same weight will retain about 1 gallon. The total estimated quantity of dip which the animals carry out and retain, plus what is required to charge the vat, should equal the total, if none is lost by leakage or otherwise wasted.

The capacity of the vat is usually calculated in the following manner: Multiply the average length in inches by the average width in inches, then the product by the depth in inches; this will give approximately the number of cubic inches of space to be filled with dip. Divide this by 231 (the number of cubic inches in a gallon), and the result will be approximately the number of gallons of dip required to charge the vat. To obtain the average length add the length at the bottom to the length at the top (that is, at the line to which the vat is to be filled), and divide the sum by 2. Obtain the average width in the same manner. The depth should be taken at the middle of the vat, and should be from bottom to dip line only and not the top of the vat. Likewise, in determining the length and width, measure only the space to be filled with liquid and not above that line. The capacities of the various tanks are obtained by a like process. Gauges or rods should be prepared and marked to show the number of gallons at various depths in the vat and tanks.

After the vat is filled to the required depth the contents should be mixed well by stirring, in order that the dip may be of uniform strength and temperature throughout. A good method of stirring the dip is to take a pail or empty dip container in which a wire bail has been fastened, attach a rope or dipping fork to the bail, allow the vessel to fill and partially sink, then drag it rapidly from one end of the vat to the other, repeating the operation several times. Stirring plungers also are useful implements, and, as they are easily made, one or more should be provided at every vat. Their use is similar to that of the dasher of an old-fashioned hand churn. The plunger is pushed to the bottom of the vat and raised rapidly, the process being repeated as the operator moves slowly along the vat. The style shown in figure 8 is the one commonly used.

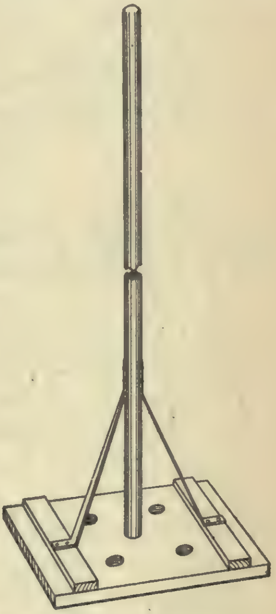

FIG. 8.—Stirring plunger for mixing liquids in the vat.

Before beginning operations the pens, chutes, slide board, vat, etc., should be examined for projecting nails, broken boards, or any object that may puncture or wound the cattle, as the dip may injure those having fresh wounds. The animals should be handled as carefully as possible, although in dipping wild range cattle the attendants can exercise very little control in the matter. Range cattle, not accustomed to being handled, are easier to dip than tame farm animals, as they go through the chutes and enter the vat more readily than the tame ones. After the animals have started running through the chute it often is necessary to restrain them to prevent their piling up and drowning in the vat. At large dipping plants a gate usually is provided in the chute near the intake to the vat so that the animals in the chute may be held back and allowed to pass only as room is made for them in the vat. If the chute has no gate, a bar which can be slipped across the chute between the side boards will answer the purpose. Gentle farm animals, and especially old milch cows, usually do not enter the vat readily—in fact it is often necessary to push them on the slide board.

Whenever there are crusts or hard scabs they should be broken and hand dressed with a solution of the dipping fluid so as to soak the affected parts well before the cattle are dipped. Visibly affected cattle should be held in the vat 2 or 3 minutes and their heads submerged at least once, but only for an instant, and assistance should be rendered promptly if they appear to be strangling. Men with dipping forks should be stationed along the vat to duck the head of the animal and to keep the animal's entire body submerged except its head. This may be done by placing the dipping fork over the withers and pushing the animal under the dip. The two styles of dipping forks shown in figure 9 are the ones commonly used. They may be bought ready-made or may be made by any blacksmith.

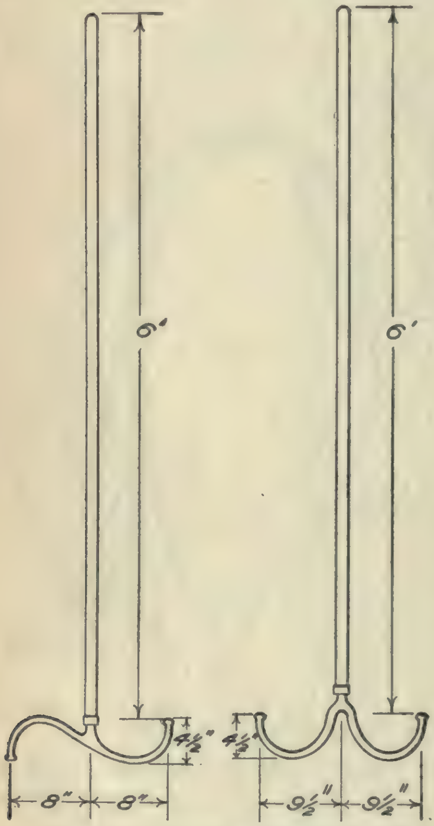

FIG. 9.—Two styles of cattle-dipping forks.

After the cattle leave the vat they should be held in the draining pens until all surplus dip has drained from their bodies.

The dip in the vat, regardless of the number of animals that may have been dipped in it, should be changed as soon as it becomes filthy. In cleaning the vat the entire contents, including all sediment and foreign matter, should be removed.

DIPS FOR CATTLE SCAB.

In selecting a dip for cattle scab the conditions under which it is to be used should be considered. If the dipping plant is supplied with soft water any of the dips recommended for scab may be used, but if the water is very hard the dip that mixes best with the water available should be selected. Hard water may be "broken" by using sal soda or lye, but no more should be added than is required to soften the water. From 1 to 4 pounds of sal soda to each 100 gallons of water usually is sufficient. The lime-sulphur dip mixes well and may be used in hard water without injury to the animals from that cause, but it is more effective when used in soft water. The nicotin dips are suitable for use in any reasonably good water. While it is possible to cure scab with coal-tar-creosote dips if they are used in soft water, they sometimes injure animals; they may fail to cure the disease when used in some of the hard waters, and apparently for the reason given in the next paragraph they can not be depended upon even when soft water is used.

Dips deteriorate by use; that is, after a number of animals have passed through the vat the active principle of the dip falls below the standard required for effective work and under certain conditions some of the dips may injure the animals. Consequently the Department of Agriculture does not give permission for the use of any dip in the official dipping of cattle for scabies unless it has been shown to the satisfaction of the Bureau of Animal Industry (1) that the strength of the dip when diluted ready for use may be determined satisfactorily in the field by the use of a practical, portable testing outfit; (2) that under actual field conditions the dipping of cattle in a solution of definite strength will eradicate scabies effectually without injuring the animals. At present the only cattle-scabies dips that fulfill these requirements are lime-sulphur and nicotin.

LIME-SULPHUR DIP.

In dipping cattle for scabies the lime-sulphur dip should be used warm. The temperature of the dip while the animals are in it should be maintained at from 95° to 105° F.

Lime-sulphur dip is made in the proportion of 12 pounds of unslaked lime (or 16 pounds of commercial hydrated lime) and 24 pounds of flowers of sulphur or sulphur flour to 100 gallons of water. The lime and sulphur should be weighed and the water measured; do not trust to guesswork. Slake the lime in a shallow, water-tight box or tank and add water enough to form a thin paste. Sift the sulphur into the paste and mix well with a broad hoe until a mixture of about the consistence of mortar is formed, adding water as required. Put the mixture into 30 gallons of boiling water, adding it slowly so as not to interrupt the boiling, and boil until the sulphur disappears from the surface. The boiling should be continued from 1½ to 2 hours without cessation, and the mixture stirred to prevent settling and caking on the bottom. When the sulphur has disappeared from the surface and the mixture is of a chocolate or dark-amber color the boiling should be discontinued.

The contents of the boiling tank should be drawn off or dipped out and placed in the settling tank and allowed to stand until all solids have settled to the bottom and the liquid is clear. The use of some sort of settling tank provided with a bunghole is an absolute necessity, unless the boiler is so arranged that it may be used for both boiling and settling. An ordinary water-tight barrel will serve very well for a settling tank at a small vat. A settling tank of any kind should have an outlet at least 4 inches from the bottom in order that the clear liquid may be drawn off without its becoming mixed with any of the sediment. (See fig. 10.) Drawing off the liquid as indicated above has an advantage over dipping it out, for the reason that in the latter case the liquid is stirred more or less and mixed with the sediment. The prime object is to get the clear liquid without any sediment; the latter under no circumstances should be allowed in the dipping vat, as it may injure the animals.

When fully settled draw off the liquid into the dipping vat and add warm water enough to make a total of 100 gallons of dip. When mixed and cooked as specified above the concentrate is 3⅓ times the strength required for the dip in the vat, so that to every 30 gallons of such concentrate 70 gallons of warm water should be added to make a dip of the required strength.

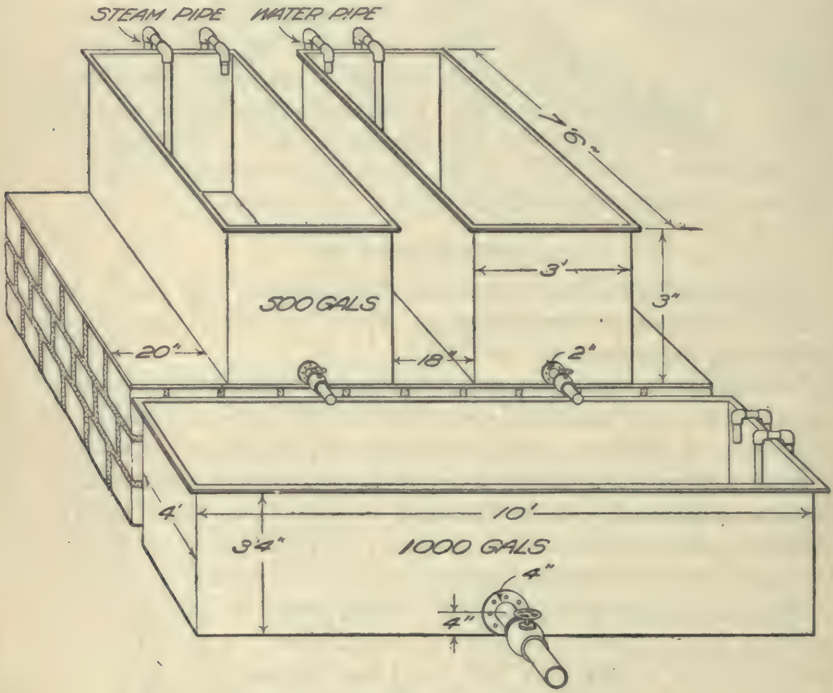

FIG. 10.—Cooking and settling tanks.

In preparing lime-sulphur dip in large quantities several hundred gallons of concentrate are often made at one time in a single large cooking tank. The quantity made at one boiling is limited only by the facilities at hand. If the boiling tank is of sufficient capacity, a large enough quantity of the dip should be cooked at one time to dip the herd. The quantity of mixture in the cooking tank may be varied at will, but the proportions of the various ingredients should not be altered.

Proprietary brands of lime-sulphur dip may be purchased, and many of them are equal to or even better than the homemade product. Ready-prepared dips should be diluted and used in accordance with instructions on the container.

NICOTIN DIPS.

The nicotin dips are sold under various trade names, and farmers and live-stock growers are more or less familiar with them from using them as dips for animals and as insecticides for insect pests of plants. When diluted with water so that the solution contains not less than five one-hundredths of 1 per cent of nicotin, they are efficacious remedies for cattle scab. If used much stronger than that they may injure cattle, especially if the animals are dipped while hot, but if properly used and maintained at proper strength they cause no injury. A field test has been designed by one of the large manufacturers of nicotin dips so that the percentage of nicotin in the dipping bath may be ascertained at the vat side at any time. Nicotin dips should be used in accordance with the instructions printed on the label of the container. Do not use any preparation whose strength is not given on the label.

Nicotin dips are used warm, but should not be heated above 110° F. During dipping operations for scab the temperature of the nicotin dip should be maintained at from 95° F. to 100° F.

Sulphur is sometimes added to nicotin dips in the proportion of 16 pounds of flowers of sulphur to 100 gallons of diluted dip. Very little of the sulphur is dissolved in the dip, but part of it remains in suspension in the bath during dipping and becomes lodged on the skin of the animal, where it remains for a long time with beneficial effect

CRUDE-PETROLEUM DIPS.

As two dippings in either of the dips already described will cure chorioptic and common scab, the crude-oil dips are not commonly used for either of these varieties of cattle scab. Crude oil is very useful, however, in treating cattle for sarcoptic scab and has proved to be an effective remedy for that disease. One of the greatest drawbacks to its use is that the oil is liable to injure animals, especially if freshly treated cattle are moved rapidly, exposed to bright sunshine, or become chilled.

Unprocessed crude petroleum is the natural crude oil which has not been subjected to any manufacturing process and it is the most effective crude-oil dip. However, processed crude petroleum, which is the residue from the manufacture of gasoline and other light hydrocarbons, is commonly used as a cattle dip and is effective in eradicating sarcoptic scab of cattle. There are also on the market several proprietary brands of crude-petroleum dips, consisting of processed crude oil to which other ingredients have been added.

In dipping cattle in crude-petroleum dip fill the vat with water to within 1 foot or 18 inches of the dip line and then add the oil until the surface of the dip is flush with the dip line. The oil floats on the water, forming a layer from 12 to 18 inches deep, depending on the quantity added, and as the animals pass through the vat their bodies become coated with oil. The oil dips are used cold and one dipping usually is sufficient to cure sarcoptic scab.

When cattle are dipped in any of the crude-petroleum dips a cool, shady place should be provided near the dipping vat where they may be quiet and protected from the sun for several days. If this is impossible the oil dips should not be used, as serious injury is liable to result from exercise or exposure to bright sunshine soon after dipping in oil.

DIPPING PLANTS.

The farmer who has but a small number of animals to dip may use a portable galvanized-metal vat (fig. 11). These vats may be purchased ready-made, and they will answer the purpose very well for dipping small lots of light or medium-weight cattle. After digging a trench and setting the vat so that the top is flush with the surface of the ground, a chute and a slide board should be provided as a means of getting the animals into the vat.

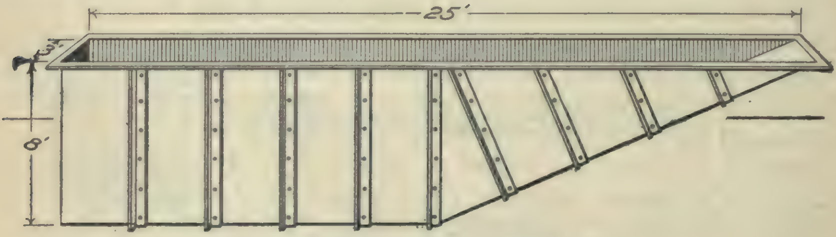

FIG. 11.—Portable galvanized-metal dipping vat.

A permanent dipping plant is much more satisfactory, and when a number of farmers in a community wish to dip their cattle a good plan is for them to contribute in proportion to the number of cattle owned and use the fund in building a community dipping plant.

Two styles of dipping plants are shown in the plans (figs. 12 and 13). Either is suitable for dipping cattle or horses for any purpose. The chutes, draining pens, etc., shown in one set of plans, may be substituted if desired for those shown in the other.

SELECTING A LOCATION.

In selecting a location for a dipping plant the fact that animals work better upgrade should be considered, and the corrals and running chute should slope up to the entrance end of the vat. The vat should be on level ground, preferably extending north and south, with the

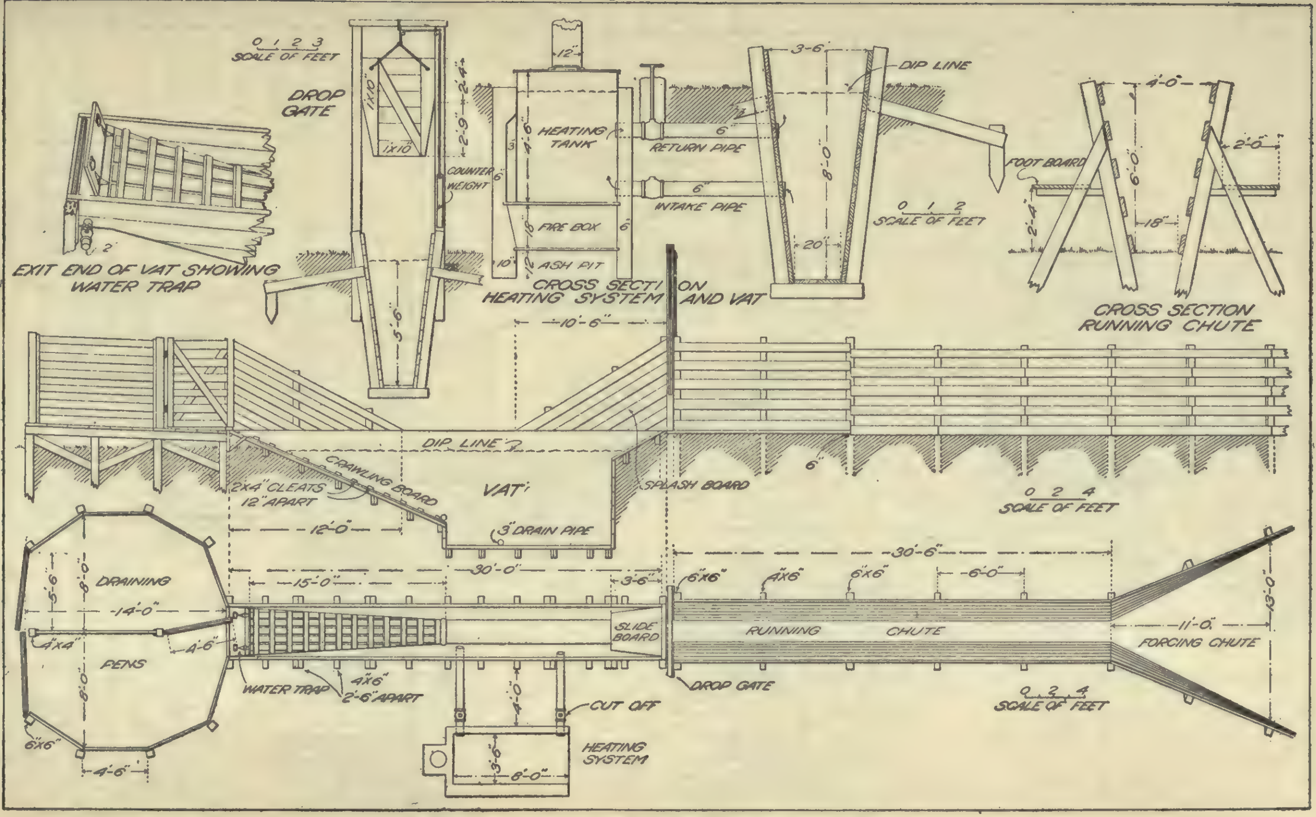

FIG. 12.—Plan of cattle-dipping plant with wooden vat.

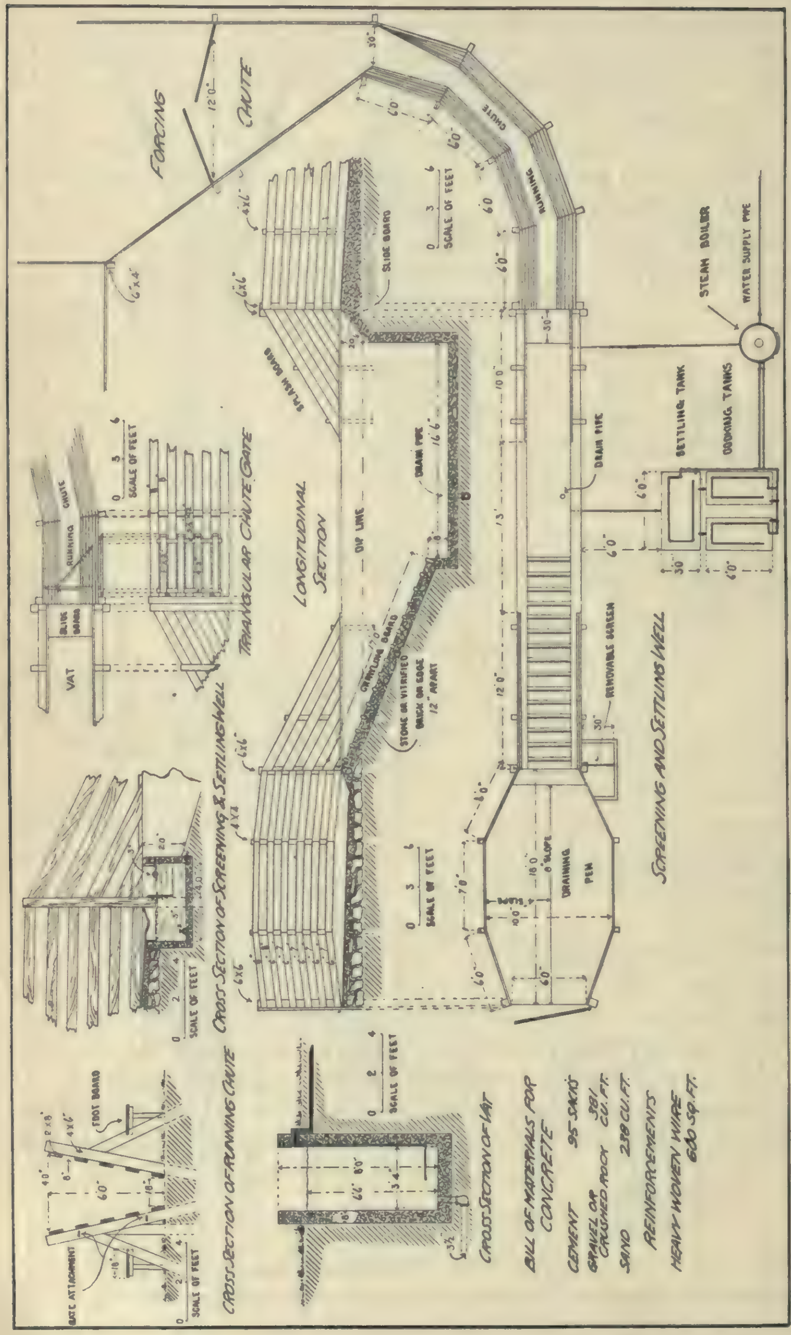

Fig. 13.—Plan of cattle-dipping plant with cement vat.

entrance at the south and the exit at the north, as it has been observed that animals work better when not facing the sun. A considerable quantity of water is used in dipping, so the dipping plant should be close to an adequate supply. The vat, however, should not be built on low, marshy land or where flood waters overflow.

CORRALS AND CHUTES.

The set of receiving corrals, into which the animals are driven preparatory to dipping, as well as the set of holding corrals, into which they go from the draining pens, should each be large enough to hold the largest herd to be dipped. They should be constructed so that there may be the least possible numbers of corners in which the cattle may become crowded and injured.

The proper design and construction of the chutes is important, because improperly constructed chutes add greatly to the difficulty of getting cattle into the vat and often cause rough handling of the animals. The running chute should be at least 30 feet long and preferably curved to prevent the approaching animals from seeing the vat. Two styles of running chutes and crowding chutes are shown in the plans, and dimensions and structural details are given. Two styles of chute gates also are shown. Most stockmen probably prefer the triangular gate. A drop gate like that shown in figure 12 may be adapted for use either as a check gate in the chute or as a holding gate in the vat. A holding gate in the vat at the beginning of the exit incline should be provided in order that visibly affected animals may be held in the dip the required length of time.

DRAINING PENS.

When cattle emerge from the vat they carry out some of the dip, which runs off their bodies very rapidly. The dip should be saved and returned to the vat, not only because it may be used over and over again, but because if it is allowed to drip off in the holding corrals it will collect into pools, from which the animals may drink with possibly injurious results, and even if no cattle are injured in that way the mudholes which form are highly objectionable. Draining pens with water-tight floors sloping toward the vat or draining wells should be provided to catch and return the dip to the vat. The size shown in the plans may be increased or decreased to correspond to the length of the vat. The floors of the pens may be made of lumber or cement and should have settling wells or water traps to prevent rain water from running into the vat and diluting the dip. A design of a settling well is shown in connection with the cement vat and one of a water trap with the wooden vat. The settling well may be used with the wooden vat, in which case the water trap would be unnecessary, as the settling well serves the same purpose.

In constructing the draining pens of cement it is advisable to build the outer walls in the same manner as the foundations for a house, except that they are to be 8 inches thick. The space inside the walls is then filled with gravel to the required height and the sloping floors laid on the tamped gravel. To prevent slipping, the cement floors should be roughened with a stiff broom while the concrete is soft, or a coat of pebble dash may be applied. If wooden floors are used they should be double, with a layer of tar paper between the two floors. Rough lumber may be used for the lower floor but the top one should be of matched boards 1 inch thick. Cleats should be nailed on the floor to prevent the cattle from slipping.

VATS.

The dipping vat may be constructed of either cement or lumber, the former being preferable, as when properly made it is more durable and in many other ways more satisfactory than the latter. The sides may be perpendicular, as shown in the plans for a cement vat (fig. 13), or sloping as shown in those for a wooden vat (fig. 12). Sloping sides for either cement or wooden vats are generally considered to be more desirable than perpendicular ones. Both styles, however, are shown in the drawings, because some stockmen prefer vats with perpendicular sides. The dimensions shown in the cross section of the wooden vat may be followed in constructing a cement vat with sloping sides.

The length of the vat may vary from 24 to 100 feet, depending on the number of cattle to be dipped. The top may extend from 9 to 18 inches above the surface of the ground or may be flush with it. A vat of the former kind affords better conditions for handling the cattle than one of the latter kind. If it is desired that the top be flush with the ground the vat should be built so that it extends 5 inches above the natural surface of the ground, which is then graded up with gravel or cinders, and a dry path along each side of the vat thus provided.

The slide board should be made of or covered with a smooth-surfaced material, such as planed lumber or sheet metal. A piece of boiler plate makes an excellent slide board. The dimensions of the slide board shown in connection with the cement vat are those commonly used. A short, steep slide board causes the animals to plunge abruptly into the dip, while a long, gradual slope allows them to slide in more gently. The short, steep slope has the advantage that the animals can not brace themselves on it for a leap so easily as on the long, gradual slide. The exit incline or crawling board should be about 16 feet long, so that the incline may not be too steep.

If permanent pipes are used for conducting water and dip to the vat they should be laid so as not to act as obstacles to the men working along the vat, but they should enter the vat above the dip line so that any leakage may be detected. There should be no obstruction in the path along both sides of the vat; neither should there be over the top of the vat any crosspieces that may interfere with the proper handling oi the cattle while they are in the dip.

The wooden vat shown in the plans has sloping sides, but, as already stated, they may be perpendicular if desired. When soft wood is used for the frame timbers they should be 6 by 6 inches, but if hard wood is used 4 by 4 inch timbers are sufficiently large for the purpose. Cedar posts make good framing timbers, as they do not rot rapidly. Matched planks 2 inches thick should be used in building the vat, and they should be beveled so that all joints and seams may be properly calked with oakum and rosin or similar material.

A water trap with hinged cover is shown in the exit incline of the wooden vat. While dipping is in progress both the cover and the valve to the drainpipe should be closed, but when dipping is finished for the day both should be opened so that water from the draining pens in case of rain may not run into the vat and dilute the dip.

When homemade lime-sulphur dip is to be used it is necessary to provide cooking tanks (fig. 10). The cooking may be done in open boilers having a fire box under each, or live steam may be piped into them for boiling the dip. It is also necessary to provide some means of heating the dip in the vat. Two systems of heating the dip in the vat are shown in figs. 12 and 13. When the open-tank heating system, shown in the plans of a wooden vat, is used, settling wells are not necessary, as the heating tank answers the purpose of a settling well. This system has an advantage over the old-style coil heater in that it is easy to keep the pipes from clogging.

The heating system shown in connection with the plans for a cement vat is the one commonly used. When steam is used the boiler should have a capacity of at least 25 horsepower. The steam pipes should extend along the floor of the vat at least two-thirds of the length and be provided with openings for the escape of steam into the dip. A check valve should be placed in the steam line to prevent dip from the vat from flowing into the boiler when the pressure is low. The water condensing from the steam passing into the vat dilutes the dip to a slight extent, and for this dilution an allowance should be made in replenishing the dip.

The trench for the vat should be excavated so that the inside dimensions correspond to the outside dimensions of the completed vat. If the sides of the trench are reasonably firm they may be used for the outer walls of the form, but in all cases in which the vat is extended above the surface of the ground it is necessary to build forms extending from the ground surface to the top of the vat. If the soil is sandy or the walls cave in it will be necessary to use outer forms, in which case the trench should be wide enough for them.

The forms usually are made of 1-inch boards and 2 by 4 inch braces, but as a supply of 2-inch lumber is necessary for the corrals and chutes, some of it may be used first for the forms and afterwards for constructing corrals and chutes. Two methods of bracing the forms are illustrated (figs. 14 and 15).

Bolts for fastening the slide board and the drain and other pipes should be placed in position in the forms before the concrete is laid. The concrete side and end walls may be reinforced with heavy woven wire, in which case the reinforcements should be placed properly in the forms so that they may be embedded in the middle of the walls.

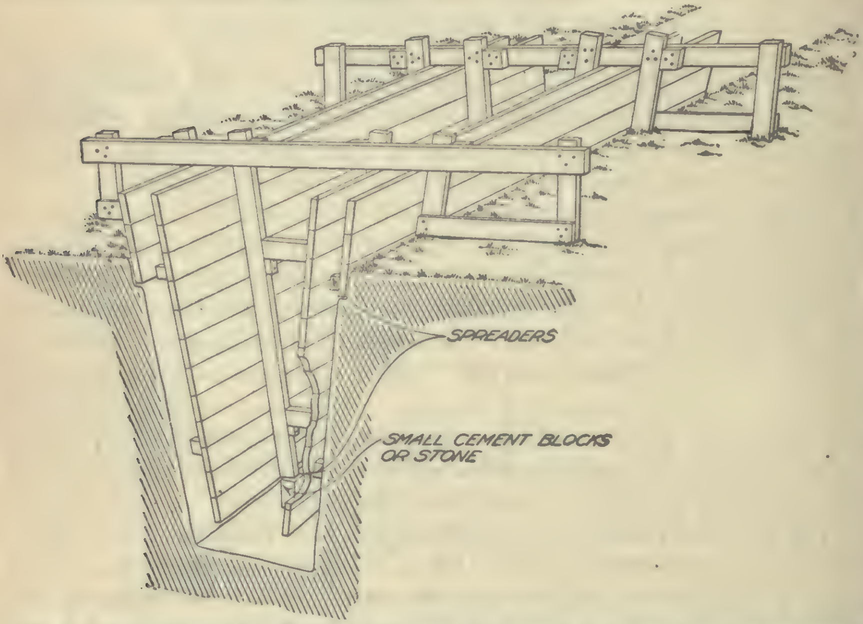

FIG. 14.—Section of trench for cement vat with sloping sides, showing the forms in place and one method of bracing.

The concrete for dipping vats should be made of 1 part of Portland cement by measure, 2½ parts of sand, and 4 parts of screened gravel or crushed stone. The sand should be coarse, clean, and free from foreign matter. The crushed stone or gravel may vary in size from one-quarter to 1 inch in diameter. The mixing should be done on a smooth, tight platform and the sand and rock measured separately in a bottomless box 2 feet long, 2 feet wide and 1 foot deep, having a capacity of 4 cubic feet. For the 2½ cubic feet mark the inside of the box 7½ inches up from the bottom. Each sack of Portland cement is considered to be equal to 1 cubic foot. Mix the sand and cement thoroughly, add the crushed stone (previously drenched with water), and mix the whole mass by turning it several times with shovels.

Then add water in a depression made in the center of the pile and mix well by turning several times with shovels, adding water enough during the mixing to make a "quaky" or thin, jellylike mixture.

The placing of the concrete in the forms should be commenced as soon as the mixing is finished. The floor and exit end should be laid first and the concrete well tamped. In filling the forms the concrete should be well settled into place by spading rather than by tamping, and special attention should be given to spading next to the inside forms to force the coarse particles back and allow the sand-cement mortar to form a dense, water-tight surface. An old hoe straightened out makes a good spading tool, as the handle is long enough to reach the bottom of the forms. If it is necessary to stop work for the day before the forms are filled the surface of the concrete in the forms should be roughened with a stick. Just before placing additional concrete, wash the roughened surface and paint it with cement and water mixed to the consistence of thick cream. Leave the forms in place 2 or 3 days, if possible, and wet the concrete daily. After the forms are removed, dampen the surface of the concrete and apply a finishing coat composed of 1 part of cement and 2 parts of sand, or mix cement and water to the consistence of cream and apply it, brushing well to form a smooth surface.

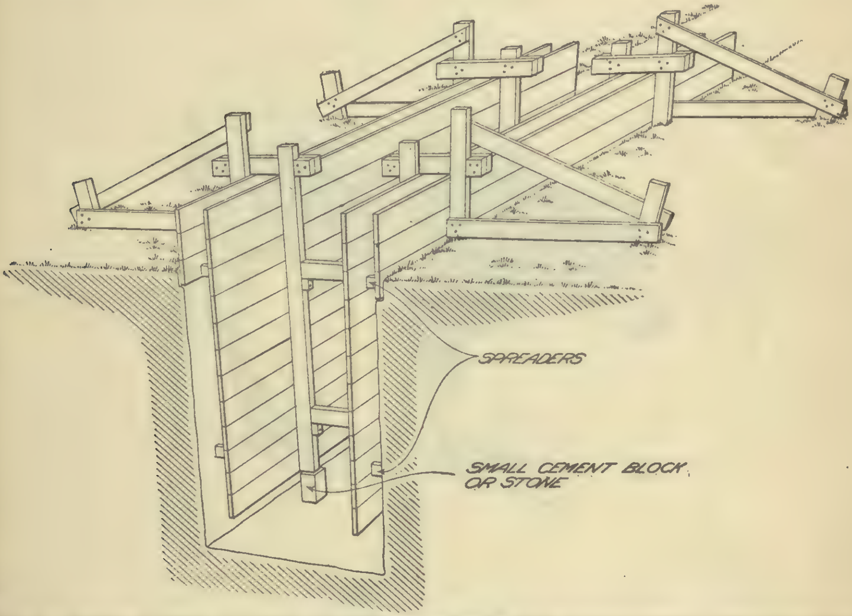

Fig. 15.—Section of trench for cement vat with perpendicular sides, showing forms in place and another method of bracing.

HEMORRHAGIC SEPTICEMIA

STOCKYARDS FEVER, SWINE PLAGUE, FOWL CHOLERA, ETC.

HENRY J. WASHBURN
Pathological Division

FARMERS' BULLETIN 1018

UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from the Bureau of Animal Industry
JOHN R. MOHLER, Chief

Washington, D. C. October 1918

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HEMORRHAGIC SEPTICEMIA is an infectious disease, attended with a very high mortality, which attacks various species of animals, especially cattle, sheep, and swine. The losses are greatest among young animals, especially those that are thin in flesh and poorly nourished. The disease is a septicemia or poisoning of the blood, wherefore it often runs a short course and the animal dies quickly.

In cattle the disease is sometimes termed stockyards fever. In hogs it is known as swine plague, and the acute form usually is fatal a few hours after the appearance of the first symptoms.

In sheep the disease frequently manifests itself in the acute form, with marked depression, high temperature, labored breathing, muscular trembling, and colicky pains. Fowl cholera represents the avian or bird form of hemorrhagic septicemia, pigeons and geese being quite as susceptible as other species of poultry.

No form of treatment has time to become effective for any animals that may be affected. The apparently healthy animals should be separated from the diseased and placed in clean, uninfected quarters, where they should have the best of feed and water. Bacterins (bacterial vaccines), which may be purchased from most American drug stores, have proved to be effective in many instances in checking the spread of an outbreak and in protecting the unaffected portion of the herd or flock.

HEMORRHAGIC SEPTICEMIA.

Stockyards fever, swine plague, fowl cholera, etc.

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Disinfection of premises 8

CAUSE OF THE DISEASE.

HEMORRHAGIC SEPTICEMIA is caused by an organism (*Bacillus bipolaris septicus*) belonging to the group in which the bacilli of chicken cholera, swine plague, and rabbit septicemia are to be found. This group is known also by the name of Pasteurella. Bacilli which resemble closely the organism of hemorrhagic septicemia are widely distributed in nature. They have been found in the soil, upon various plants, in stagnant water, and upon the moist nasal membranes of normal calves and hogs. In several instances these harmless organisms have been so increased in virulence by passing through animals that they finally proved to be fatal when injected into pigs, and in those instances the tissue changes, which were found at the autopsy of the pig, were similar to those found in swine that had died from swine plague.

Some writers think that after the organisms have become virulent enough to cause an outbreak among animals, and the infection has been overcome, they will return later to their previous harmless stage. The increased virulence which is made evident by an attack of several animals of a single species appears to be effective only in animals of that particular species, and the disease does not readily spread to other species. For example, hogs and sheep that are pastured with a drove of cattle in which several deaths occur from hemorrhagic septicemia usually remain unaffected, although on another farm the sheep or the hogs alone may contract the disease and all the cattle escape. If any exceptions to this rule occur they are extremely rare.

Attempts have been made during an outbreak of hemorrhagic septicemia among cattle to transfer the disease from affected to healthy animals by rubbing saliva from diseased cattle into the mouths of healthy animals, and by injecting serum from the blood of a diseased yearling beneath the skin of young cattle, but without success. Many attempts to infect hogs by natural means from diseased cattle also have failed. In one instance, however, a colt that fed from the rack with a number of diseased sheep contracted the disease and died.

The spread of the disease seems to depend nearly as much upon the condition and susceptibility of the animal as upon the contagious nature of the disease, as thin, poorly nourished young stock most frequently become infected and die.

SYMPTOMS.

In cattle the disease develops very rapidly, lasting from 1 to 8 days. There is usually a steady elevation of body temperature until from 104° to 107° F. is reached. The animal refuses its feed. Swelling may appear beneath the skin of the head, throat, or dewlap. These enlargements are somewhat soft and pit on pressure. The tongue is often extensively swollen, and the animal drools and slobbers because of the irritation to its tongue and throat. There may be difficulty in breathing, depending on the degree of involvement of the air passages and of the lungs. Occasional coughing may occur. Muscular trembling may be evident. There may be a blood-stained discharge from the nostrils, and strings of mucus may hang from the mouth. Examination of the nostrils often reveals the presence of many small hemorrhages, or blood spots, just beneath their lining membranes. The eyelids become highly inflamed and tears flow.

There is an intestinal form in which the changes are found chiefly in the abdominal cavity, or the intestinal form may develop after the disease has appeared in the lungs. The stomach, intestines, and kidneys and the lymph glands belonging to them become studded with hemorrhages of various sizes, and the intestines become intensely inflamed. The consequence is that diarrhea sets in, and shreds of mucus and bloody droppings are passed. The intestinal form is rare, as most cases show severe involvement of the lungs and the symptoms of croupous pneumonia. The animals may stand with their forelegs wide apart in order to breathe more freely. They lose flesh very rapidly, their abdomens become "tucked up," and the eyes quickly become sunken. A staggering gait, caused by extreme weakness, sometimes is noticed.

A disease has been described under the name of septic pleuropneumonia of calves, which is a form of hemorrhagic septicemia caused by a closely related germ. The symptoms shown by the affected calves are quite characteristic of hemorrhagic septicemia, and the post-mortem findings are also those found in that disease.

In sheep, young animals which have just been weaned are found to be most susceptible, the disease manifesting itself in an acute form. There is marked depression, high temperature, labored respiration, loss of appetite, muscular trembling, and frequently colicky pains. A subacute and a chronic form of the disease are also recognized, the latter affecting principally older sheep. Aside from the changes caused by fever, weakness, etc., there is noted in the subacute form a discharge from the eyes and nose which at first is watery, later being mixed with matter. There may be also pulmonary impairment (pneumonia), or there may be evidence of inflamed intestines. Occasionally the symptoms subside only to return in a more chronic form, which manifests itself principally as a chronic affection of the lungs, with gradual emaciation. Sometimes the joints are involved, swelling of the knee joints being noted rather frequently. Recent reports from Colorado tend to show that hemorrhage septicemia has become rather prevalent among the sheep of that State. It is asserted that bacterins have been used very satisfactorily in several of these outbreaks.

In swine the disease sometimes manifests itself in a very acute form, the animal showing symptoms of general blood poisoning. Red spots may be noted on various parts of the body, especially around the ears and on the neck and rump. When affected with this form of disease the animal usually dies within a few hours after the first symptoms. In acute swine plague the disease usually occurs as a form of pneumonia in which portions of the lungs become degenerated and cheesy. There is labored respiration, dry, spasmodic cough, a slimy discharge from the nose, sometimes a purulent inflammation of the eyelids, bluish-colored membranes, constipation followed by diarrhea, the droppings containing blood. The animal becomes very thin and usually dies in from 1 to 2 weeks. Sometimes the acute form changes into the chronic type, in which case the acute symptoms subside, and the cough and evidence of pulmonary involvement continue for a considerable time. Progressive emaciation occurs and a chronic inflammation of the joints may develop. The animals die in from 3 to 6 weeks from exhaustion. Sometimes, however, the affected parts of the lung may become encapsulated (inclosed in a membrane), and the animals may even be fattened in spite of the condition of the lungs.

ANATOMICAL CHANGES.

Swellings will be found under the skin. If these enlargements are examined they are found to consist of collections of jellylike material tinged with blood. Occasionally they are limited to a single shoulder or flank, when they may be mistaken for blackleg. The lymph glands are enlarged and are injected with blood. The mucous membranes which line the respiratory tract are similarly affected. False membranes composed of fibrinous exudate (or discharge) may develop in the throat. The spleen remains normal. Hemorrhages are constant in the fatty tissues around the kidneys and within the walls of the intestines.

When the disease is chiefly in the chest the lungs are darkened in color and their fibrous tissues much thickened from the collection of bloody serum in their meshes. The diaphragm, heart sac, and heart walls show numerous bloody points and larger collections of blood.

In the intestinal form hemorrhages into the intestines are present and sloughing of the lining of the intestinal wall is observed, as a result of which the intestinal contents are wrapped in a covering of bloody mucus.

In acute forms the animals may die suddenly and the changes in such cases are not very marked. Microscopic examination of the body fluids demonstrates the presence of germs enough to prove the nature of the trouble.

DIAGNOSIS.

Because of their acute course, high fever, and rapid termination in death, some difficulty may be experienced in distinguishing anthrax (carbuncle), malignant edema (swelling), and blackleg from hemorrhagic septicemia. The differentiation of hog cholera from hemorrhagic septicemia of swine also presents many puzzling points.

There may be swelling of the throat or neck in either anthrax or hemorrhagic septicemia. An examination of the spleen of the affected animal will give a conclusive diagnosis, for the spleen of an animal dead from anthrax nearly always becomes acutely swollen and its pulp becomes softened. In cases of hemorrhagic septicemia small hemorrhages are usually present in the kidney fat. Bacteriological examination will demonstrate quickly the presence of the specific organisms of anthrax or of hemorrhagic septicemia, and a test should be applied in all doubtful cases. The value of a definite diagnosis will be recognized when the lasting nature of an anthrax infection, with its consequent lowering of the value of the affected premises and the more transitory character of an outbreak of hemorrhagic septicemia, are considered.

Blackleg and malignant edema may be detected usually by the formation of gas within the swellings upon the body, and the bubbles thus developed will produce a crackling sound if the fingers are pressed over the affected area. Further, in blackleg the marked change in the affected muscles and the characteristic "rancid-butter" odor noted in cases of blackleg facilitate a differential diagnosis.

Hemorrhagic septicemia of swine, commonly termed swine plague, usually appears as a form of pneumonia. The symptoms readily point to an attack of pneumonia, but the presence of roundworms in the lungs may cause identical manifestations, making a positive diagnosis somewhat difficult. The long course of pneumonia should be taken as an indication that the pig is not affected with swine plague.

It is very difficult to distinguish swine plague from hog cholera. The two diseases may occur in the same animal. Should the outbreak seem to be but slightly contagious and not inclined to spread from the premises upon which it first appeared, it is probably not hog cholera, but if it spreads rapidly throughout the neighborhood, it is undoubtedly due to hog-cholera infection. The presence of the characteristic bacilli does not alone establish a diagnosis of swine plague, since those organisms are found frequently as secondary invaders in true cases of hog cholera, and again they are often present in the noses and throats of healthy swine.

PREVENTION.

Through the use of bacterins animals and fowls may be protected experimentally from contracting hemorrhagic septicemia. Cattle, sheep, swine, rabbits, and fowls, if treated with heated cultures of hemorrhagic septicemia germs obtained from animals or birds of the same species as that to which they themselves belong, will almost invariably become protected against injections of living cultures of the same germ, even though applied in comparatively large quantities. Tests made by the Bureau of Animal Industry have shown that the use of cultures from animals of another species often affords similar complete immunity. Sheep have been made immune from virulent cultures obtained from other sheep by the use of prepared cultures from cattle. Rabbits have been made resistant to hemorrhagic septicemia cultures, derived from a variety of different species of animals, by treatment with prepared cultures coming from animals of other species. Fowls have been protected from injections of deadly quantities of virulent fowl-cholera organisms by the use of prepared bouillon growths of the same germ, or by the use of strains of the fowl-cholera bacillus possessing but little virulence.

Closely allied germs have at times very important differences in living characteristics which must be taken note of in applying the correct bacterin, to get the best results in producing immunity.

In the October, 1916, issue of the American Sheep Breeder, Dr. W. H. Lytle, Oregon State veterinarian, reports very satisfactory results from vaccination with a weakened culture of the living organism. About 3,000 sheep were treated with the material. After 48 hours subsequent to the vaccination of the flocks only nine sheep in all were lost, although before inoculation several animals died each day. Bacterins made from the killed organisms of hemorrhagic septicemia have been used also with considerable success in Oregon sheep.

TREATMENT.

In most cases treatment of a fully established case of hemorrhagic septicemia in an animal of any species is quite useless. All apparently well animals should be removed from sick ones by placing them in separate, noninfected quarters. If new cases develop among them in a few days after their removal, the healthy ones remaining should be removed again to another locality. In that way the unaffected animals soon will be out of danger of further contamination, especially if their strength has been supported by an abundance of good feed and water during the separation.

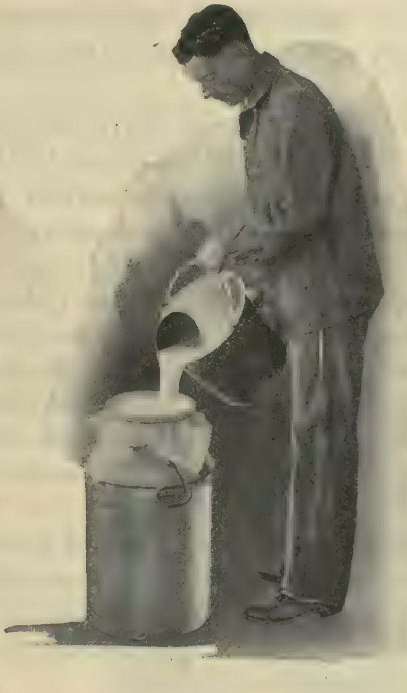
DISINFECTION OF PREMISES.

Premises usually become infected with hemorrhagic septicemia by stock cattle that have recently passed through some of the larger cattle markets. Owing to this method of infection the stables and yards may not be so completely contaminated as they would be if the disease had developed spontaneously. In any event, all stables, sheds, or yards that have contained infected animals should be disinfected. The interior of the stables, especially the mangers and manure trenches, should be washed with a disinfectant, such as liquor cresolis compositus (U. S. P.) or carbolic acid, 6 ounces to a gallon of water in either case. The yards may be disinfected by the application of a solution made of 5 ounces of copper sulphate to a gallon of water. The best way to apply disinfecting solutions is to use a spray pump such as is used in spraying orchard trees. All refuse and material from the stable and barnyard should be removed to a place not accessible to cattle, sheep, or hogs. The manure should be spread on fields and plowed under. A plentiful supply of light and air should be provided for the contaminated stables. Open fields or pasture lands are cleansed rapidly by the action of sunlight.

O

STRAINING MILK

ERNEST KELLY and JAMES A. GAMBLE
Dairy Division



FARMERS' BULLETIN 1019

UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from the Bureau of Animal Industry
JOHN R. MOHLER, Chief

Washington, D. C. January, 1919

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SEDIMENT in milk indicates carelessness in its production or handling.

Sediment contaminates milk and makes it less salable.

Most of the sediment in milk comes from the bodies of cows and consists of hairs, manure, bedding, etc.

Straining removes only the coarse particles of dirt and removes neither the bacteria nor the fine dirt.

Straining improves the commercial quality of milk, but does not appreciably improve its healthfulness.

The best system is to prevent, so far as possible, the entrance of dirt into milk. This can be done best by having clean cows in clean stables, milked with clean hands, into clean, small-top pails.

Filter cloth and absorbent cotton are efficient materials for strainers. Cheesecloth and wire gauze are less effective.

Straining cloths should be changed whenever they become soiled. They should be thoroughly washed and sterilized after each using. Efficient sterilization is accomplished by boiling or exposure to steam for at least five minutes.

Keep dirt out.
Strain through cotton or filter cloth.
Use only clean, sterile strainer cloths.

STRAINING MILK.

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SIGNIFICANCE OF SEDIMENT IN MILK.

MILK, as it leaves the udder of a healthy cow, is clean and pure. It contains relatively few bacteria and no appreciable quantity of visible dirt. When cow hairs, particles of manure, bedding, or dust are found in milk they are evidence that the product has not been protected properly during milking or subsequent handling. On the other hand, the absence of visible sediment does not prove that the milk is clean, for it may have been carefully strained after careless production.

The entrance of dirt into milk is objectionable from two standpoints—sanitary and economic. The contamination of milk by manure may add organisms which are injurious to health. Schroeder[1] states:

> The real danger from tuberculous cattle lies in the manner in which tubercle bacilli are disseminated with their feces.

He found that tuberculous cows cough up and swallow tubercle bacilli, which pass through the digestive system and are excreted in the droppings. If particles of this matter get into the milk, they carry with them bacteria, which are capable of producing tuberculosis in human beings or in other animals that consume the milk. Economically also the presence of dirt in milk is a disadvantage. Dirty milk is not so readily marketed as clean milk. Consumers are becoming more critical as to the appear-

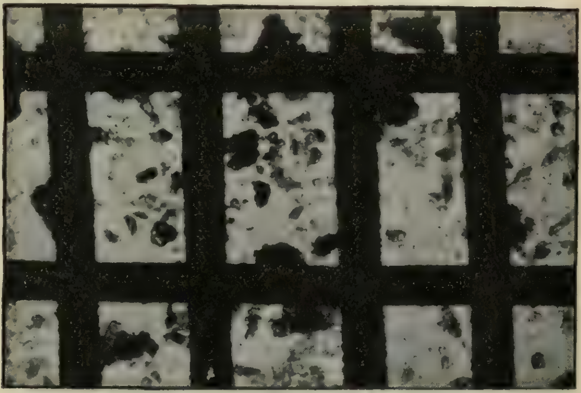

FIG. 1.—Wire strainer enlarged, showing relative size of wire mesh and dirt particles.

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[1] Bureau of Animal Industry Bulletin 99, page 13.

NOTE.—This bulletin deals only with straining. It does not discuss other methods of removing dirt from milk.

ance of the milk they buy. Milk contaminated with dirt contains greater numbers of bacteria, hence it is liable to sour more quickly. Ayers, Cook, and Clemmer[1] found that in fresh, unstrained milk there was "a general relation between the sediment and the bacterial count."

SOURCES OF SEDIMENT.

By far the greater part of dirt in milk comes from the body of the cow. Other sources are the air, the hands and clothing of the milker, and unclean strainers, pails, cans, and other utensils. A very great proportion of the dirt in milk is composed of hairs, manure, straw, hay, etc., which drop into the milk from the body of the cow during milking. Hay, chaff, and dust also may fall or be carried by the wind into milk either during milking or afterward, if it is left exposed. If the milker's hands are dirty or his hat or clothing dusty, some sediment may be carried into the milk from these sources. Unprotected pails, cans, bottles, or other utensils may accumulate dust. When milk comes into contact with them the dirt is washed off.

WHAT STRAINING DOES.

Straining, if properly performed, removes a large part of the visible dirt which may have fallen into the milk. For this reason it is useful commercially in improving the appearance of the milk. It must be borne in mind, however, that straining removes neither the bacteria nor disagreeable flavors that the dirt carries into the milk. In other words, bacteria can not be strained out of milk, nor does the process improve the healthfulness of the product to any appreciable degree. The reason for this fact is that bacteria are much smaller than the meshes of the finest strainer. Thus they slip through easily while the larger particles of dirt are caught and removed from the milk. Figures 1, 2, 3, and 4 illustrate this very clearly. Figures 1 and 2 are from photographs, magnified about 50 times, of the meshes of a wire and of a

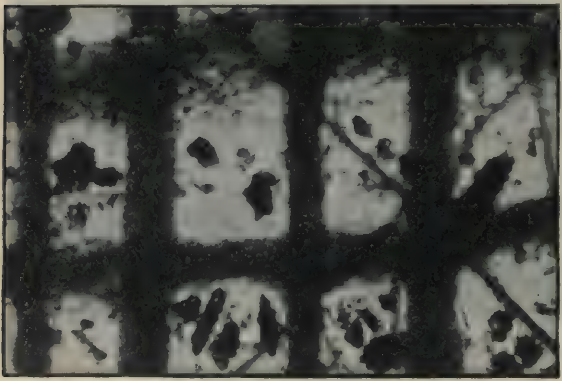

FIG. 2.—Cheesecloth strainer enlarged, showing relative size of cloth mesh and dirt particles.

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[1] Department of Agriculture Bulletin 642, page 35.

cheesecloth strainer showing the relative sizes of the openings and of dirt particles from the body of a cow. It is evident that, though the cow hairs and coarser dirt are held by these types of strainers, many small particles pass through. This can be demonstrated readily by

FIG. 3.—Wire strainer greatly enlarged, showing relative size of mesh and bacteria. The small dots are the bacteria.

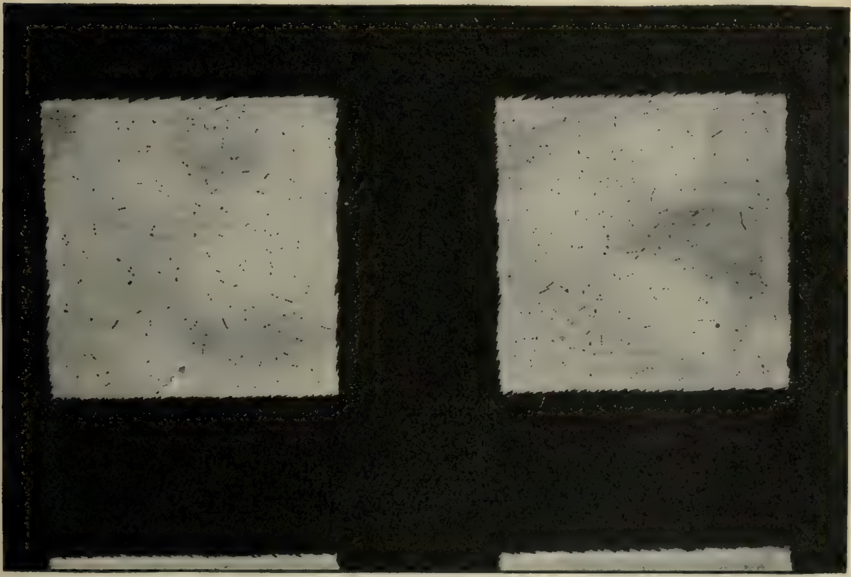

FIG. 4.—Cheesecloth strainer greatly enlarged, showing relative size of mesh and bacteria. The small dots are the bacteria.

straining a pint of dirty milk through such a strainer into a glass jar or pitcher. After standing for a short time much sediment will be found in the bottom of the receptacle.

Taylor[1] determined that 85 per cent of fresh manure dissolves in milk, 83 per cent being moisture and 2 per cent solid material. He also found that 91 per cent of the undissolved manure was visible as sediment at the bottom of the bottle, while 9 per cent was held in suspension in the milk.

Figures 3 and 4 show why it is impossible to strain out bacteria from milk. They represent meshes of wire and of cheesecloth strainers greatly magnified so as to show the relative sizes of the meshes and bacteria. The small dots in the meshes are bacteria. This emphasizes the impossibility of straining out bacteria except those which adhere to the larger particles of dirt.

KEEPING DIRT OUT OF MILK.

In view of the facts presented it is evident that the wisest course is, so far as possible, to prevent the introduction of dirt and bacteria into milk, and to use the most efficient straining method to take out all the sediment that can be removed.

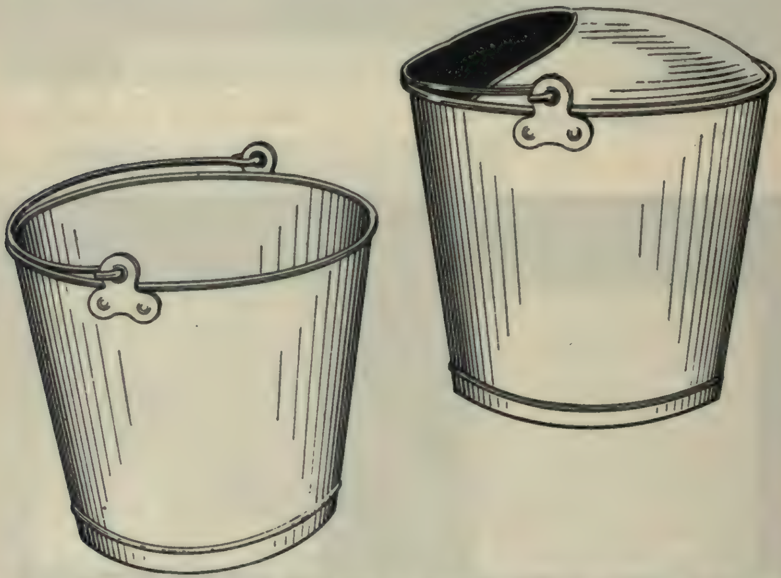

FIG. 5.—Small-top milking pail made from an ordinary pail by the addition of a hood.

Since the body of the cow is the chief and most dangerous source of milk sediment, preventive measures must begin there. Cows should be groomed frequently to remove loose hairs, bits of manure, or bedding. In addition the flanks, udder, and adjacent belly should be cleaned with a moist cloth just before milking. If these parts are kept clipped they will be much easier to clean.

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[1] Journal of Dairy Science, November, 1917, vol. 1, No. 4, page 303.

Most of the dirt which gets into the pail from the body of the cow falls vertically during milking. A large part of it and its contamination may be kept out of milk by the use of a hooded or small-top milking pail, as illustrated in figure 5. It can be made from an ordinary milk pail by the addition of the hood, which can be soldered on by any tinsmith at small expense. Many types of small-top pails are on the market, but the one illustrated combines satisfactorily the desired points, which are cheapness, ease of use, durability, smallness of opening, and ease of cleaning.

The Dairy Division has examined and scored several thousand milk samples, produced on more than a thousand farms. Figure 6 shows the relative quantities of sediment found in these samples, classified according to the type of milking pail used. Ayers, Cook, and Clemmer[1] publish photographs which emphasize this point, and state further: "The original cost of a small-top pail is little more than that of an open pail; it is no more expensive to care for and is of distinct value in preventing the entrance of manure and dirt into milk; consequently it should always be used."

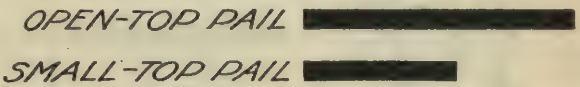

FIG. 6.—Relative quantities of sediment in milk drawn into open-top and small-top pails.

Dust in the stable air is liable to get into milk. For this reason every precaution should be taken to have the air pure during milking. Handling dry feeds, especially hay, should not be done just before or during milking. Sweeping the stable during these periods is equally objectionable. If the stable is built with tight ceilings and smooth walls, it will be easy to clean, and dust will not readily collect in sufficient quantities to contaminate the air heavily.

The milker's hands should be washed thoroughly and kept clean during milking. If they are allowed to become dirty they are liable to be a source of dirt in the milk, especially if "wet-hand" milking is practiced. The clothing of the milker should be free from dust, which may fall into the milk pail.

Care is necessary to protect the milk from dust and dirt after it is drawn. Except when the milk is actually being poured into the strainer, it should be kept covered at all times to prevent the entrance of dust and insects. Much fine sediment is often blown on to the strainer if the latter is left uncovered during the intervals between straining.

Figure 7 illustrates a device which can be made readily on any farm to protect milk during straining. While the milk is being poured into the strainer the cover is raised by a foot pedal. When the pedal is released the cover automatically drops back, serving as a protection against flies and dirt.

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[1] Department of Agriculture Bulletin 642, page 33, and Plates I, II, and III.

Milk should be kept in tightly covered receptacles at all times. Many farmers remove the covers from the cans during cooling to allow the "animal heat" to pass off. This practice is unnecessary and gives opportunity for considerable contamination.

Pails and cans after they are washed and sterilized should be inverted to drain and dry in a clean place, preferably the inside of the milk house. Strainer cloths may be hung in a similar place. If these utensils are placed where dust can be blown into them they will collect dirt which will subsequently appear as sediment in the milk.

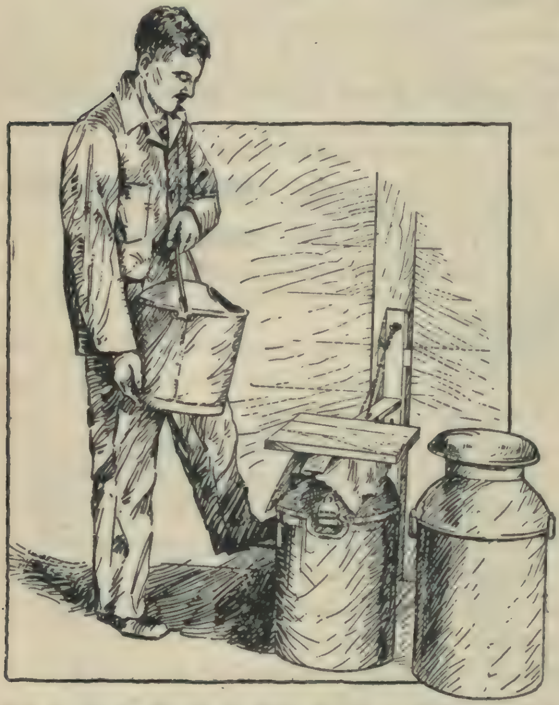

FIG. 7.—Cover device for strainer. It is in place, but is raised by the pedal while milk is being strained.

MILK STRAINERS.

Even in dairies where great care is used, a certain quantity of dirt gets into the milk, while on many dairy farms, where milk production is not so highly specialized and other farm activities require the bulk of the available labor, less time is given to cleaning the cows and caring for the milk. Under these conditions it is not surprising to find considerable sediment in many samples of market milk. For this reason it is desirable to strain carefully all milk to remove, so far as possible, the sediment which it may contain.

EFFICIENCY OF VARIOUS KINDS.

Milk strainers are made of various materials, the most common being wire gauze, cheesecloth, cotton cloth, canton flannel, filter cloth, and absorbent cotton. Reports recently received show the kinds of strainers used on about 40,000 farms in all parts of the United

States. The following table, arranged in the order of efficiency of material from poorest to best, summarizes the information given:

Kind of strainer:	Per cent of farms.
Wire	35
One thickness of cheesecloth	16
Cotton cloth or more than one thickness of cheesecloth	27
Filter cloth	1
Absorbent cotton	21
	100

Keeping in mind the figures shown above let us consider whether the present systems of straining generally used are as efficient as they should be. Figure 8 gives a graphic representation of the quantities of sediment in milk after straining through various materials. This illustration is the compilation of figures obtained in scoring several thousand milk samples in competitive contests, where information concerning methods used in production was available. It will be noticed that the milk strained through absorbent cotton or filter cloth contained the smallest quantity of sediment, while wire strainers were least effective in removing dirt.

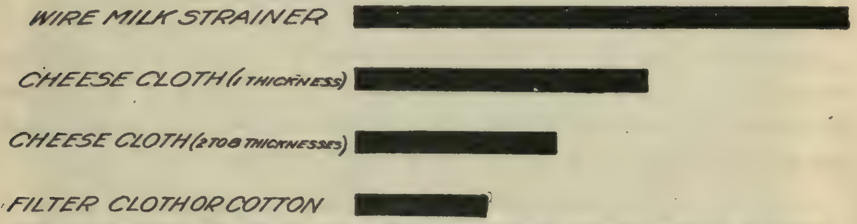

FIG. 8.—Quantity of sediment in milk after straining through various materials.

To demonstrate further the relative efficiency of various straining materials, a series of tests was made in which a measured quantity of manure was placed in each of several bottles of milk. The milk was then strained, a different type of strainer being used for each bottle, after which it was allowed to stand for some time before the bottoms of the bottles were photographed to show the sediment that passed through the strainers. The results are shown in figures 9 to 14. In these pictures figure 9 is the photograph of the milk before straining, showing the amount of sediment present. Figure 10 shows the sediment remaining after straining through a wire strainer, which removed hairs, straw, and some of the coarser particles of manure, but did not take out a very appreciable part of the fine sediment. That a single thickness of cheesecloth permits a large quantity of sediment to remain in the milk is shown in figure 11. Cheesecloth folded so that the milk has to pass through several thicknesses (figure 12) did not remove all the sediment.

Figure 13 shows dirty milk after straining through a filter cloth. This filter cloth is made of cotton in much the same manner as a carpet; that is, it is smooth on one side while the other side has a "fuzzy" appearance due to the cotton fibers. This fuzzy side is exposed in the strainer so that the milk is poured directly on to it. From the illustration it is evident that this special cloth is quite effective in removing all but a small percentage of the sediment. But most effective of all is absorbent cotton placed between two thicknesses of cheesecloth. (See figure 14.) This method removes practically all the sediment, even in very dirty milk.

Filter cloth can be bought from the leading dairy supply houses, and is comparatively inexpensive. New squares of it may be used each milking, or, if properly washed and sterilized they may be used again until the long fibers become worn. One roll of filter cloth, if properly used, should last from 3 to 6 months in taking care of the milk from a herd of 20 cows.

Absorbent cotton can be purchased at any drug store. Before using it should be split into one-third or one-fourth of its original thickness, and fresh cotton must be used each time. A 1-pound package should last about a month for a herd of 20 cows.

CLEANLINESS ESSENTIAL.

Ayers, Cook, and Clemmer[1] determined that the greatest original source of bacteria during milk production was unsterilized utensils. In a series of 50 experiments they found that when the utensils were sterilized the average bacterial count was 31,040 per cubic centimeter, but that with unsterilized utensils the count averaged 666,520 per cubic centimeter. The straining cloths must receive particular attention, for if they are not carefully washed and sterilized they will harbor millions of bacteria that will contaminate milk at subsequent milkings. It is not uncommon to find straining cloths yellow with old milk and having a strong, cheesy odor. Milk strained through such cloths can have neither a low bacterial count nor an appetizing flavor.

Strainer cloths containing 35,000,000 bacteria per square inch have been found in use on dairy farms. The area of the strainer cloth which is in contact with the milk may be 36 square inches or more, which means that the milk passing through is liable to be inoculated with more than 1,000,000,000 bacteria. Furthermore, if the cloth is folded the chances for inoculation are increased in proportion to the number of thicknesses used.

Strainers and strainer cloths, as soon as used, should be thoroughly washed with warm water and washing powder. They should then be rinsed in clean water and sterilized by boiling for 5 minutes, or with steam for the same length of time. After sterilization strainer cloths should be hung up to dry in a clean place where they will be protected from flies and dust.

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[1] Department of Agriculture Bulletin 642, p. 29.

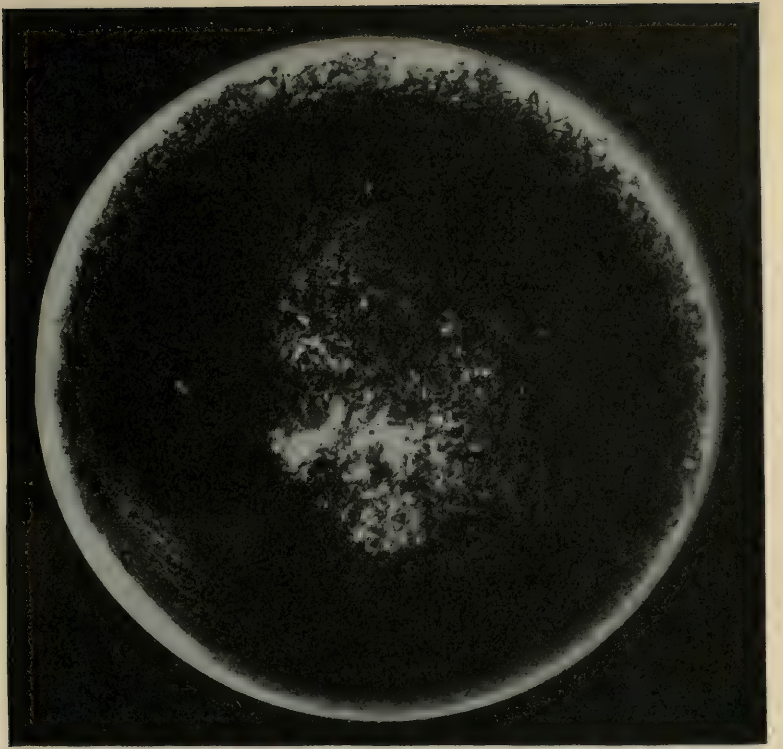

Fig. 9.—Dirty milk before straining, showing the quantity of sediment in bottom of bottle.

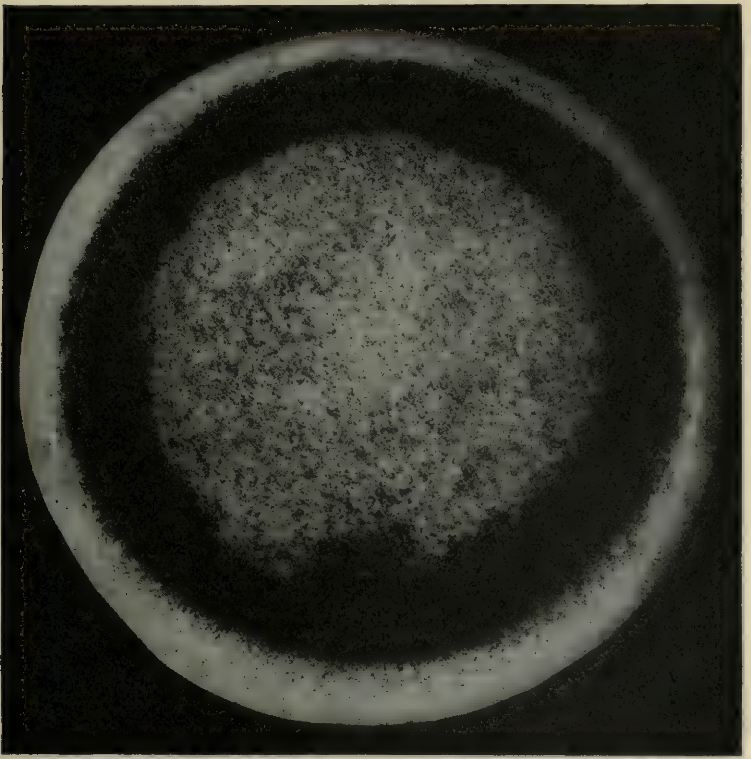

Fig. 10.—Dirty milk after straining through a wire strainer, showing quantity of sediment remaining.

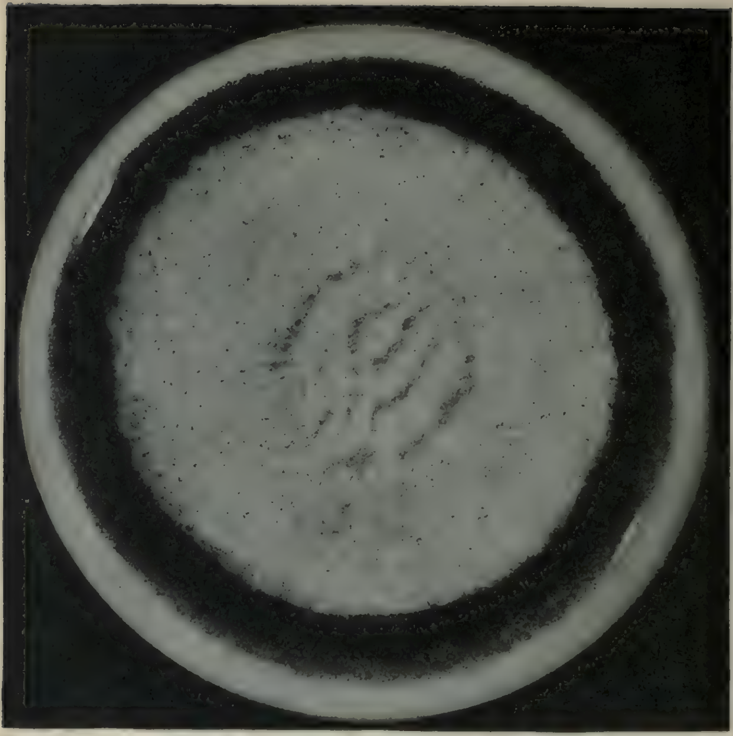

FIG. 11.—Dirty milk after straining through one thickness of cheesecloth, showing the quantity of sediment remaining.

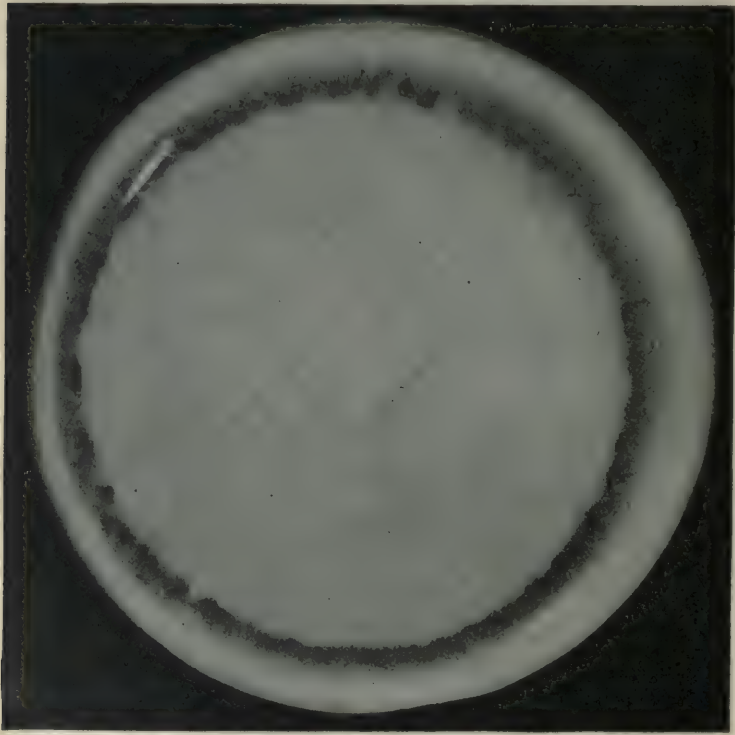

FIG. 12.—Milk after straining through 8 thicknesses of cheesecloth, showing the sediment remaining.

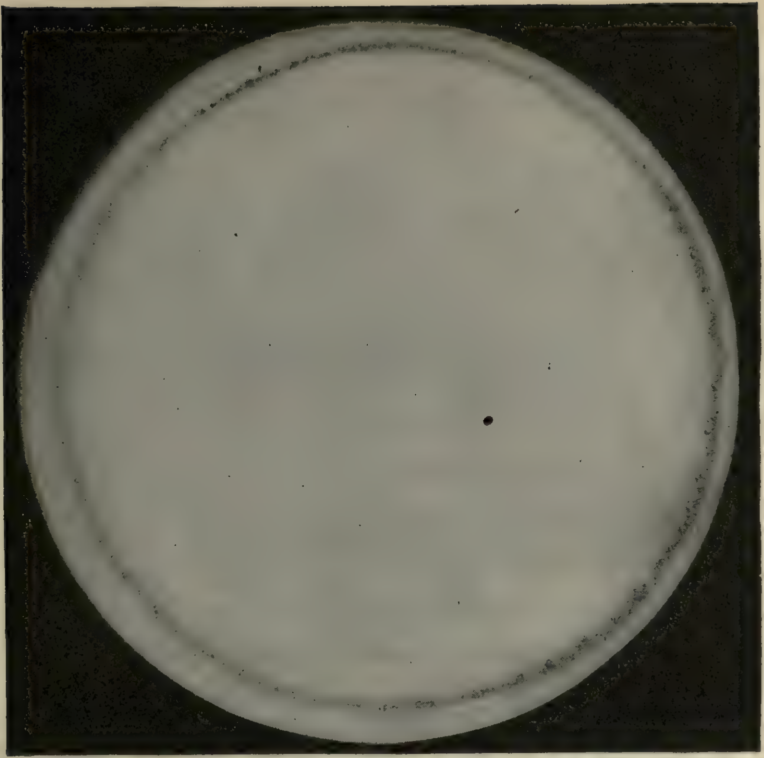

FIG. 13.—Milk after straining through filter cloth, showing some sediment remaining.

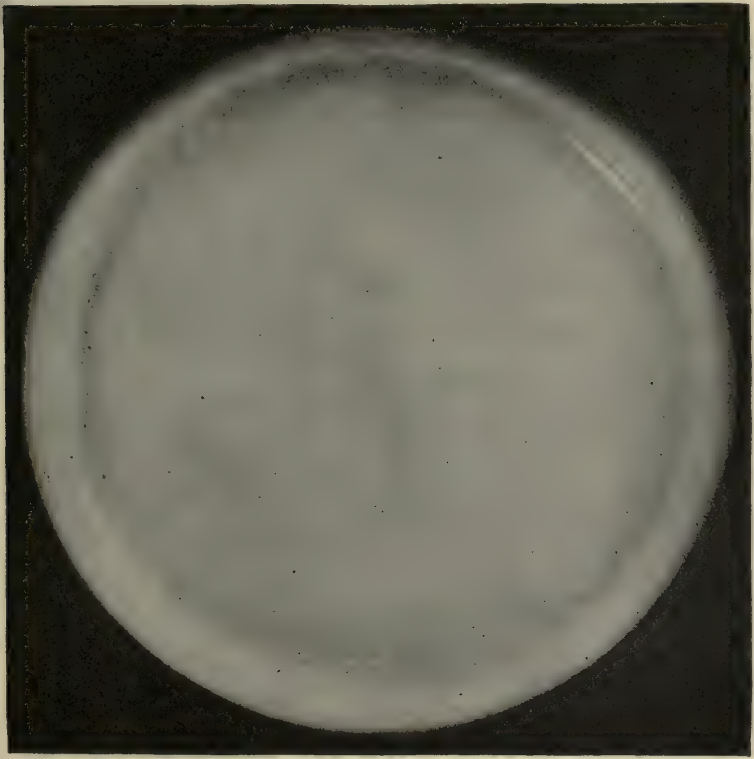

FIG. 14.—Milk after straining through cheesecloth and absorbent cotton, showing little sediment remaining.

• SUGGESTIONS.

1. The milking barn should be clean, and well lighted and ventilated. The stalls should be built with regard to the size of the cows. Droppings should fall in the manure gutter and the cows should have a clean, dry, well-bedded place on which to lie.

2. Keep the cows groomed to remove loose hair and manure.

3. Before milking wash the cows' udders and flanks and wipe with a damp cloth.

4. Milk with clean, dry hands into a clean, sterilized, small-top pail.

5. Remove the milk immediately to the milk house, where it should be strained and cooled at once.

6. Keep milk tightly covered at all times.

7. Protect clean utensils from flies and dust.

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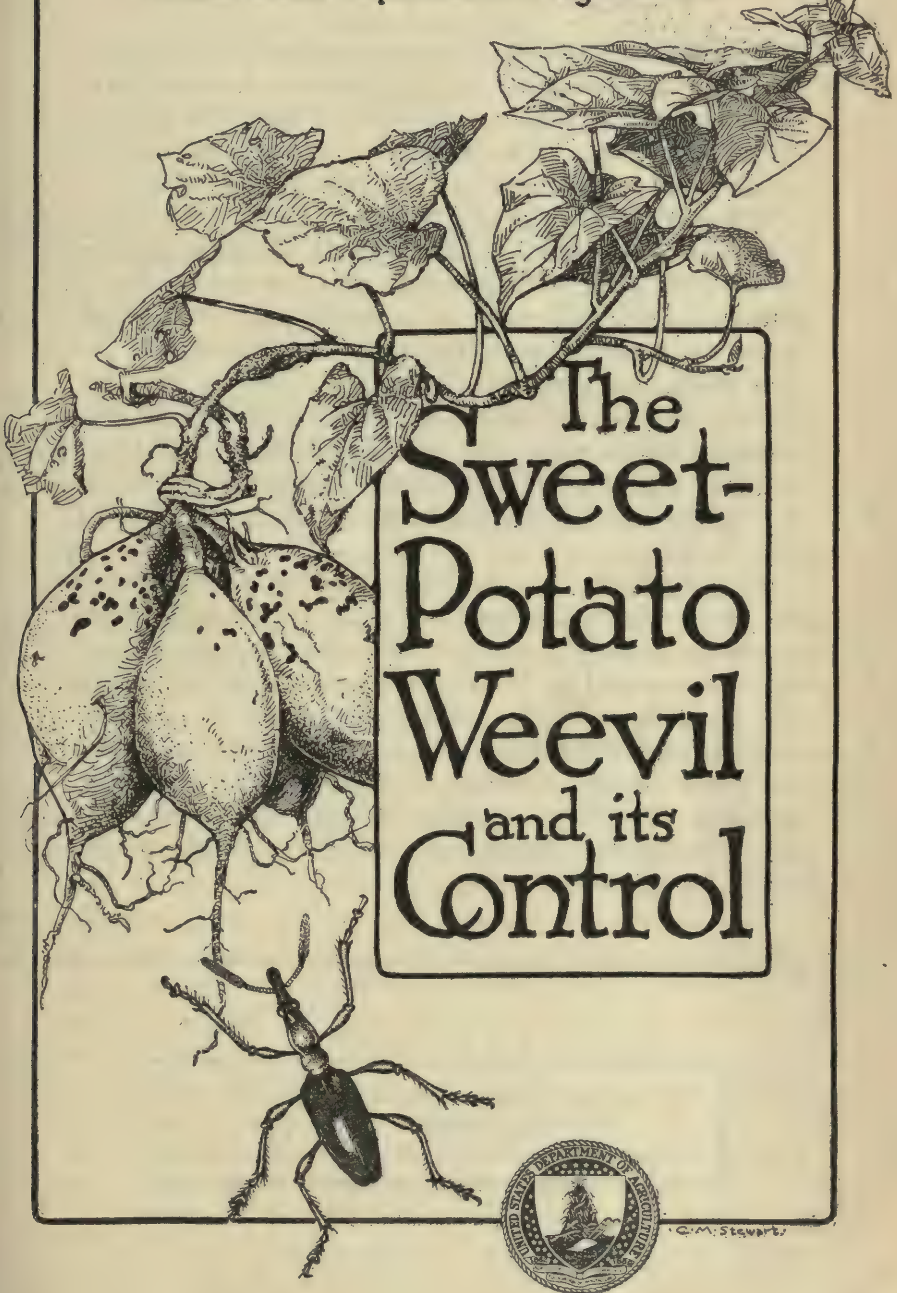
UNITED STATES DEPARTMENT OF AGRICULTURE

Farmers' Bulletin 1020

United States Department of Agriculture



The Sweet-Potato Weevil and its Control

IMMENSE LOSSES of sweet potatoes in the Gulf States are being caused by the sweet-potato weevil. This foreign pest, introduced into the United States years ago, has become very destructive recently and now threatens to invade all States in which sweet potatoes are grown.

The slender, metallic-blue weevil, about a quarter of an inch long with red legs and "waist," attacks leaves, stems, and roots or "tubers," and its whitish larvæ or grubs tunnel the stalks and roots and inflict great damage, both in the field and in storage. Owing to the increased production of the sweet-potato crop to meet war conditions, this weevil has become a pest of the greatest importance. Indeed, it is to the sweet-potato industry what the boll weevil is to cotton.

This bulletin describes the insect and its injuries and gives a sufficient account of its life history to explain the control measures advised. The weevil can be stamped out in limited regions where it has not yet secured a firm foothold, and then, by quarantines, it can be kept out of States and parts of States not yet infested. It is vitally important at present to combat, by every means available, an insect that threatens to destroy our second most valuable vegetable crop.

Contribution from the Bureau of Entomology
L. O. HOWARD, Chief
Washington, D. C. January, 1919

THE SWEET-POTATO WEEVIL[1] AND ITS CONTROL.

F. H. Chittenden,
Entomologist in Charge of Truck-Crop Insect Investigations.

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MENACE OF THE SWEET-POTATO WEEVIL.

THE growing of sweet potatoes has become one of our most important food-producing industries. Indeed, the sweet potato now ranks second as a vegetable in the United States, the value of the crop of 1917 having reached the hitherto unparalleled sum of $90,000,000 and that of 1918 being estimated at $116,867,000.

This industry is threatened by the ravages of an imported insect known as the sweet-potato weevil (fig. 1), which in the last few years has destroyed the sweet-potato crop more completely in the States where it is present than during all previous years. It has become permanently established in Texas, Louisiana, and Florida, and practically all directors, entomologists, and other agricultural officials of the Southern States have communicated with the Department of Agriculture regarding means of controlling it, and specific action has been taken by these States looking toward its eradication by quarantine measures against the infested regions.

In six States of the Union (fig. 4), in our insular possessions, and in foreign countries where the sweet-potato weevil has been reported as a pest,[2] its ravages have been severe; indeed, losses of from 25 to 50 per cent are commonly sustained, and not infrequently crops suffer so seriously from the attacks of this weevil as to be practically destroyed, the sound roots remaining being too few to justify harvesting. As a result growers of sweet potatoes become disheartened and abandon the crop for both present and future.

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[1] *Cylas formicarius* Fab.

[2] Few reports are made unless the damage is most decided. As in the case of many other crops, a monetary loss due to insects of less than 20 per cent is too frequently unnoticed by the average grower, or, if observed, is likely to be attributed to unfavorable weather or to other conditions.

Mr. Wilmon Newell, commissioner of the Plant Board of Florida, who is actively cooperating in the sweet-potato weevil investigations, in writing of this insect in the autumn of 1917, stated that from 30 to 50 per cent of the crop at digging time was lost in many portions of that State; that the roots were discarded as "weevily"; and that where the roots were stored their destruction by the weevil was completed by spring. He believed that an insect capable of making serious inroads on the sweet potato crop, if it became generally distributed throughout Florida, might cause a direct loss to the farmers of $1,000,000 annually. Many similar instances of injury have been reported in that State, as well as in Louisiana and Texas.

EXTENT OF LOSSES.

It is estimated that Texas, with a sweet-potato crop in 1917 valued in round numbers at $9,000,000, has suffered a loss of 20 per cent, or $1,800,000 a year, from the attack of this weevil; Louisiana, with a crop valued at $5,000,000, has lost about 12 per cent, or $600,000; and Florida, with a $4,000,000 crop, has lost about $400,000. Thus a conservative estimate of the total yearly loss due to the ravages of this pest in these three important sweet-potato growing States alone is $2,800,000.

The extent of injury in the States of Georgia, Alabama, and Mississippi, and in the insular possessions, Porto Rico, Hawaii, and Guam, is not known. It is impossible to estimate the money loss traceable directly or indirectly to this weevil because of the failure of planters to grow sweet potatoes through fear of a recurrence of losses sustained in earlier years. The amount, however, undoubtedly is very large and must be given serious consideration.

The loss to the Gulf country has been estimated by Newell at $3,500,000—a sum which can not be far from correct.

If radical measures for the suppression of this pest are not adopted soon, the example set by many planters who have abandoned all attempts to produce this important food crop commercially will undoubtedly be followed by others who have suffered losses, and the supply of sweet potatoes will be reduced greatly.[1]

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[1] This article must be considered as of a preliminary character and is published at the present time that the sweet-potato growers in the infested regions may be informed concerning the known facts with regard to the insect in its different stages, the losses which it annually entails, its present distribution, its food plants, its life economy as far as learned, and, above all, the methods for its control which experience has shown to be of the greatest importance. The investigations now being undertaken in the South by the Bureau of Entomology and the various State and other official entomologists will result in additional information concerning its distribution, its complete life history, the value of heat and fumigation in protecting seed potatoes, the effect of arsenicals on the insect, and the results of other methods of control which have not been fully demonstrated.

In the preparation of this article the author has had the active cooperation of Messrs. John E. Graf and C. H. Popenoe, who have conducted surveys of the infested regions, read the manuscripts, given suggestions, and furnished photographs for reproduction. Mr. M. M. High has supplied data relating to the life economy; Mr. B. L. Boyden, on the effect of carbon disulphid on the tubers. Information has been obtained also from the bulletins of Mr. Wilmon Newell and Dr. W. E. Hinds on this subject.

SOURCES OF INFESTATION.

Wherever this insect is well established the principal infestation takes place through the overwintered weevils. Weevils may winter over in three ways: (1) In stored sweet potatoes; (2) in roots left in the ground as volunteers; or (3) in those left through poor harvesting. Wherever temperatures below 10° F. are frequent during the winter these methods of hibernation are responsible for the continued presence of this pest, since that temperature is fatal to adults which are not protected. Weevils in all stages may be found in buried roots along the Gulf coast during the winter.

With regard to weevil injury no practice can be worse in infested districts than that of preserving a permanent bed of seed sweet potatoes, from which vines can be cut for planting *at the convenience of the grower.* This practice is certain to result in the transmission of an abundant supply of weevils to the main crop, and is equally certain to cause serious injury to the crop by the time it is ready for harvest.

An outbreak of the sweet-potato weevil in a new locality, remote from any other where it is known to be established, in practically every case may be traced to the transportation of propagation material from weevil-infested localities. Indeed, it is a matter of surprise that the insect has not been more widely distributed than available records show.

All sweet-potato growers, all dealers, and all transportation companies, whether railroads or steamship lines, should be posted thoroughly regarding the danger in the case. All portions of sweet-potato plants, cuttings, vines, draws, and slips, and especially seed tubers or roots, and all wild morning-glories, should be carefully examined for the presence of this weevil before being shipped from weevil-infested regions or admitted into uninfested or weevil-free regions.

The growing of sweet potatoes by small planters, for home use only, provides a potent source of infestation in the infested Gulf States. Where holdings are small, effort to store them to prevent loss is necessarily extremely limited. Many such growers practice no methods of control and count on saving not more than from 60 to 70 per cent of the entire crop, the remainder, 30 to 40 per cent, being left to the mercy of the pernicious weevil and to rot. Such small, scattered areas, in proximity to extensive farms where sweet potatoes are grown commercially, constitute a menace which it would be almost criminal to overlook.

To meet such conditions State quarantine regulations should be placed in effect that will oblige the small grower either to take proper care of his own crop or permit the same to be destroyed in *case of the impossibility of saving it by cleaning up, fumigation, or otherwise. In just such cases a duly authorized horticultural inspector or county agent could render his greatest service both to the community and to the country at large.*

The commercial grower will serve his own interests in the highest degree by pressing legislation of this character in every way possible.

DESCRIPTIVE.

The sweet-potato weevil has four distinct stages: (1) The adult, or weevil; (2) the egg; (3) the larva, or grub; and (4) the pupa, or resting stage. The grower should be able to identify these with the aid of figures 1, 2, and 3 and the following brief descriptions:

THE ADULT.

The adult (fig. 1) of the sweet-potato weevil is a snout-beetle of ant-like appearance, about one-fourth of an inch long, with metallic dark-blue elytra or wing-covers. It is slender, cylindrical, with distended or "swollen" body and long legs. The prominent head and beak are dark blue and the thorax or "waist" is brick red, as are also the sides of the legs; the long antennæ or "feelers" are yellowish red. The antennæ have long, thick clubs at the ends, and the male, which bears the longer club, can be distinguished from the female.

THE EGG.

The egg is pale yellowish, broadly oval, somewhat narrowed at the attached end; the surface is not polished, but shows slight granulation and a faint appearance of division into facets. The length is about one-fortieth of an inch (0.65 mm.).

THE LARVA.

The larva (fig. 2), when full grown, is cylindrical, robust, with the lateral edges of each segment prominent and rounded. The color is nearly pure white, the head pale brown, and the mouth-parts dark brown. A few sparse, delicate hairs can be seen under the microscope. On the thoracic segments there are three pairs of broad leg-pads. The length is about three-eighths of an inch (9 mm.).

THE PUPA.

The pupa (fig. 3) is at first of the same color as the larva, but grows darker just before transformation to adult. The wing-pads are short and narrow and are folded over on the lower side of the body. The head and back fold down upon the breast. The last segment is furnished with two backward and outward curved tubercles. On the head are several minute tubercles, each of which bears a slender hair. It is about one-sixth inch (4 mm.) long, or the same as the beetle without the beak.

The pupa is inactive, not partaking of food. The lower half of the body is mobile, enabling the pupa to turn about in its burrow or pupal case.

DISTRIBUTION.

The distribution of the sweet-potato weevil is a matter of the greatest importance, since it is necessary, in an effective "clean-up" campaign, to know the exact localities wherein the insect is established as well as to know those in which it does *not* occur.

This is especially well illustrated by reference to the Baker-Charlton region in southern Georgia and northern Florida. (See map, fig. 4.) In this area, in a comparatively restricted locality, the weevil, within the last few years, has become a menace to the sweet-potato crop, having become introduced obviously through infested propagation material. Since a most thorough survey has established that this is an isolated infestation, being confined by a well-marked boundary, and since it is possible through an effective quarantine organization to control almost completely the movement of infested roots and draws, this infested area has been selected for demonstration purposes, and a complete record of all infested farms or gardens therein

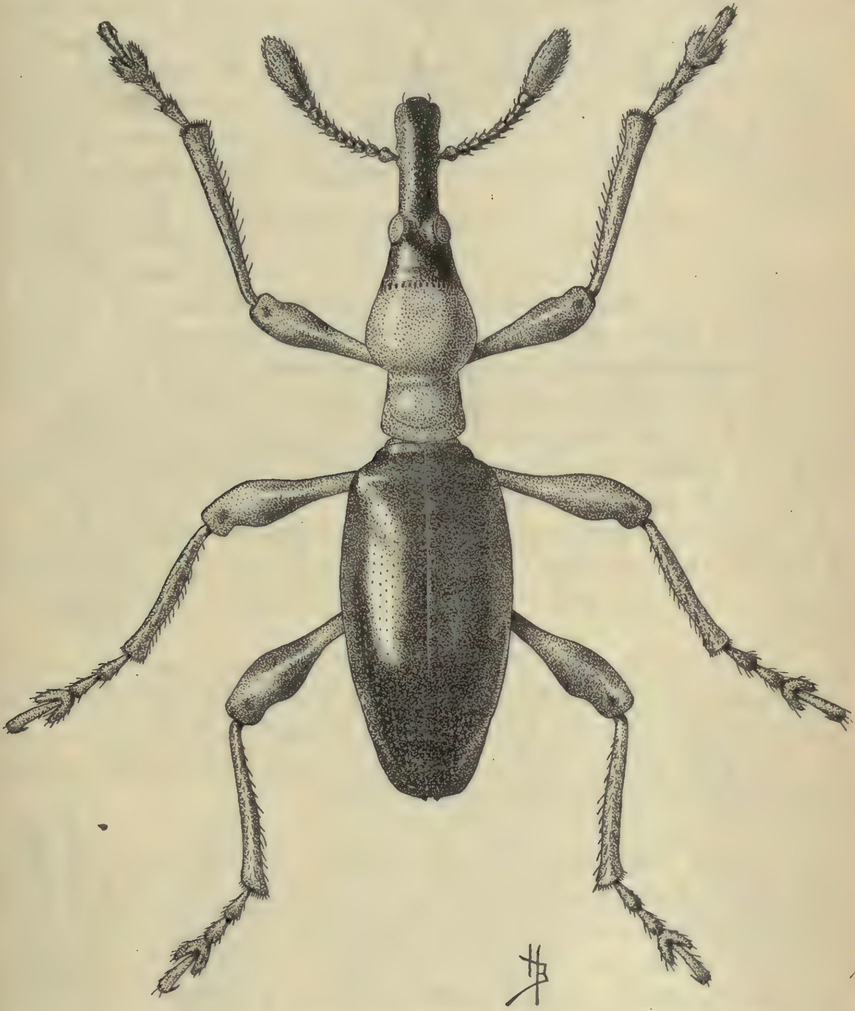

FIG. 1.—The sweet-potato weevil (*Cylas formicarius*): Adult beetle. Greatly enlarged. (Pierce.)

is available. The widespread publicity incident to the farm-to-farm survey which has been undertaken has borne fruit to the extent that a probable reduction of 25 per cent in the infested area already has been accomplished, principally through educational methods, and it is believed that within two years it will be possible to remove the quarantine now in force against this area because of the completion of projected eradication measures.

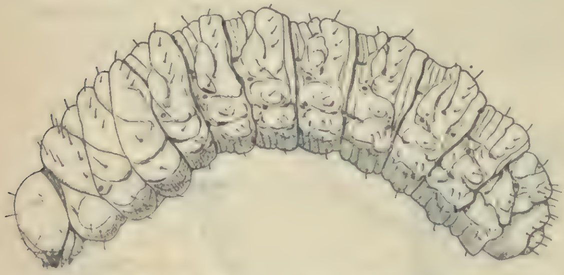

FIG. 2.—The sweet-potato weevil: Larva. Much enlarged. (Pierce.)

A similar survey of the southern counties of Mississippi, which are the only ones positively known to be infested, affords a substantial basis for the institution of control and clean-up measures there. This accomplished, the early establishment of repressive measures will operate to destroy the pest, stop its breeding, and, above all, prevent its spreading to weevil-free regions.

For these reasons, a somewhat complete consideration of the present distribution, the trend of distribution as indicated by available data, and the limits and extent of this distribution will follow.

TREND OF DISTRIBUTION.

Records show that the sweet-potato weevil was present in the vicinity of New Orleans, La., in 1875, and near Manatee, on the west coast of Florida, in 1878. Undoubtedly it was introduced with sweet potatoes at an earlier time in both localities. Since the time of these introductions, the insect has been distributed along the Gulf and Atlantic seaboard, and has spread inland from these points. Commerce along the Atlantic seaboard and through the large and small waterways has facilitated its movements, and the area of distribution has been increased through the shipment of weevil-infested sweet potatoes, intended for food as well as for seed, to still other points inland, in many cases involving considerable distances.

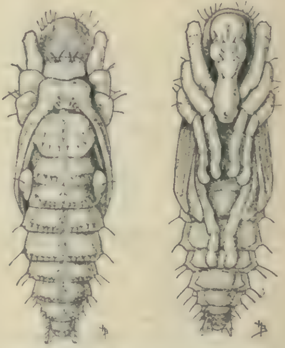

FIG. 3.—The sweet-potato weevil: Pupa, dorsal and ventral views. Enlarged. (Pierce.)

The chief points of introduction of the weevil in this country seem to have been independent of each other and its range has been extended from no single place, but from several widely separated centers, which, in addition to New Orleans, La., and Manatee, Fla., probably include Key West, Fla., in 1880, and Miami, Fla., and localities in Galveston and Harris Counties in Texas in 1890—all of which are ports of entry for the West Indies trade.

In Texas the trend of distribution is northward, in Louisiana westward and northward, with very slight movement to the East. In Florida the insect has held closely to the Atlantic and Gulf regions, having made little progress toward the interior.

A prediction that the species would move eastward into Alabama from Pascagoula, Miss., or some more eastern point has been verified by Mr. K. L. Cockerham, special field agent, who discovered the species and its injurious work in Mobile County, Ala., February 21, 1918.

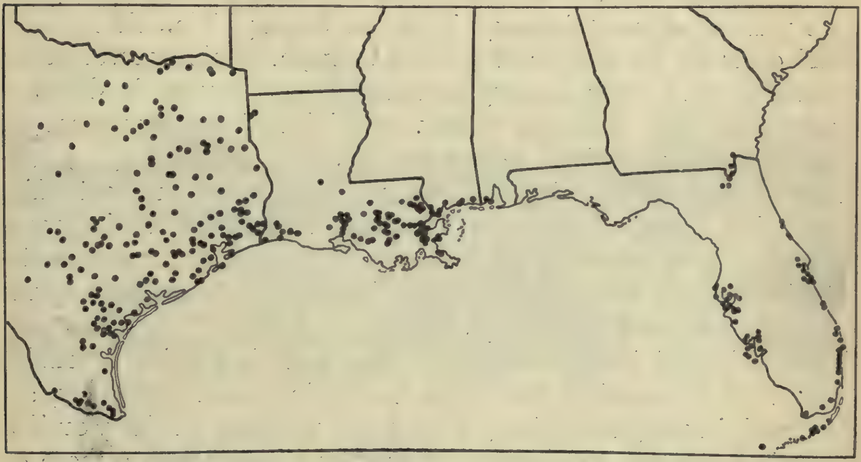

FIG. 4.—Present known distribution of the sweet-potato weevil in the southern United States.

In Texas the weevil ranges from Brownsville and Pharr on the Mexican boundary, in Cameron and Hidalgo counties, respectively, westward to Callahan County and northward to Fannin, Red River, and Bowie counties, which border the Red River. From these three counties the weevil can be carried across the river to Bryan, Choctaw, and McCurtain counties in Oklahoma, while Mill and Lake counties in Arkansas are threatened.[1]

To summarize, the sweet-potato weevil has long been an inhabitant of Florida, Louisiana, and Texas, and since the question of its suppression was raised in the fall of 1917, it has been learned that it has entered Georgia through northern Florida, or vice versa; Mississippi (in four counties) has become infested from Louisiana; and Alabama has been entered from Mississippi. Should future survey work show that infestation occurs in Tennessee,[1] a State reported as harboring the weevil, Oklahoma, Arkansas, North and South Carolina, and even Missouri and Kentucky may be invaded, unless drastic action is taken to suppress the pest along the border lines of all the States in which it has become located.

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[1] Large areas of these counties are in forest land and the acreage in sweet potatoes is small. If these should become infested the pest could be stamped out readily.

PRESENT DISTRIBUTION.

Up to November, 1917, there was no positive knowledge of the occurrence of the sweet-potato weevil in States other than Florida, Louisiana, and Texas, but it had been surmised, considering the insect's permanent establishment in Baker County, Fla., that it soon would cross the St. Mary's River into Georgia. This was verified in November, 1917, when a heavy infestation was reported in Charlton County, Ga., near the river mentioned. There is evidence that the insect was in that region as early as 1915.

Along the Gulf of Mexico there is a stretch of land, extending from Baker County, Fla., to St. Tammany Parish, La., a distance of nearly 600 miles, which up to November, 1917, had not been reported as harboring this weevil. This parish borders the State line separating Louisiana from Mississippi.

In Mississippi infestations were unearthed, beginning December 18, 1917, at Gainesville, and Lake Shore, in Hancock County, and additional investigations have shown the presence of the weevil at Ocean Springs and Pascagoula in Jackson County, and a more extensive distribution in Hancock County, while it has also invaded Pearl River County. (See map, fig. 4.) Many new localities have been reported since in this same region, the infestations varying from 5 to 75 per cent. The weevil is reported to have been present in many cases since 1915 and in one as early as 1914.

The sweet-potato weevil can survive the winter in every State where sweet potatoes are extensively grown and stored, and should its range extend farther along the lines indicated the possibilities of damage to this important crop would be enormous.

FOREIGN DISTRIBUTION.

The origin of the sweet-potato weevil is unknown, but it is assumed to be native to Cochin China, Mauritius, India, and other countries, although its exact distribution abroad never has been carefully studied. It has been recorded, however, from different portions of Asia and Africa and from outlying islands of both continents, the list including India, Ceylon, Cochin China, Hongkong, Mauritius, Uganda Protectorate, Gold Coast of Africa, Friendly Islands, Formosa, Madagascar, Australia, Hawaii, Guam, and practically all of the West Indies—Cuba, Porto Rico, Haiti, Grand Cayman, and Jamaica—and British Guiana in South America. It has also been known as a pest in Australia, at least since 1889.

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[1] A report, happily unverified, has been received of the occurrence of this insect in four counties in Tennessee. If a suspected fifth county should be found later to be infested it means that the weevil is on the border line between Tennessee and North Carolina and that the latter State is menaced. Another county, Robertson in Tennessee, borders Kentucky.

Evidence points to Cuba as the source of its introduction into the United States. This was undoubtedly before 1875, when the species first was identified in connection with injuries to the sweet potato. Introductions have taken place frequently since that time.

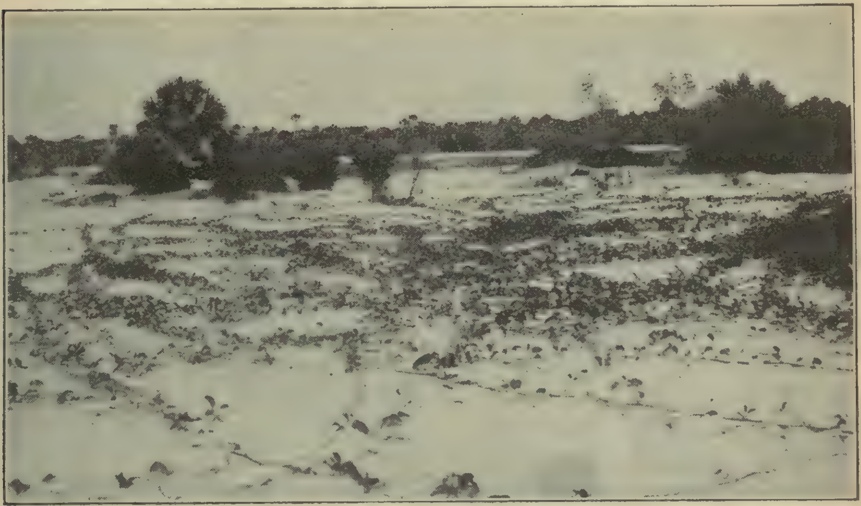

FIG. 5.—View of Florida beach, showing characteristic spreading growth of the beach morning-glory, a wild food plant of the sweet-potato weevil.

Some other localities attributed to this species in reality refer to what we now consider a distinct species,[1] with similar habits. Still another related weevil,[2] occurring in Liberia, attacks the sweet potato.

FOOD AND OTHER HABITS; NATURE OF INJURY.

The sweet-potato weevil is restricted for food to the sweet potato, including the types known in some sections as "yams,"[3] and closely related plants,[4] prominent among which is the goat's-foot morning-glory,[5] considered a natural food plant. This plant is a nearly cosmopolitan weed which grows in sandy places along tropical seashores.

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[1] *Cylas turcipennis* Boh., from Java, India, and Sarawak.

[2] *Cylas femoralis* Faust. For descriptions and other matter in relation to these species see W. D. Pierce, Journ. Agr. Research, Vol. XII, 1918, pp. 604–607.

[3] It does not attack the true yam (Dioscorea).

[4] Botanical family Convolvulaceae.

[5] *Ipomoea pes-caprae*, also called the beach vine and seaside or beach morning-glory.

Its characteristic spreading nature along the beaches of Florida is shown in figure 5. The sweet-potato weevil infests more rarely a species of wild moonvine or moonflower.[1] It breeds also on other plants of the morning-glory family,[2] and is at times extremely abundant on volunteer or wild sweet potato.

In figure 6 is shown a corner of a vacant lot in southern Florida where a mat of volunteer sweet-potato vines badly infested by the sweet-potato weevil has accumulated.

The beetles injure the sweet potato by feeding on the leaves, vines, stalks, and roots or "tubers."

The female weevil lays her eggs in the vines, and in the stalks or crowns, near the ground, as also in the roots in the field, and continues to work and breed in the roots in storage. The larvæ on hatching tunnel through the vines to the roots, the vines die, and frequently the roots become badly riddled and filled with excreta, imparting such a bitter taste that even swine will not eat them. A cross section of such a root is shown in figure 10. Within a short time, if the insects are numerous, the roots are completely destroyed, and breeding continues almost indefinitely after decay has become advanced until finally the roots become either too moist or too dry and hard to permit further weevil development.

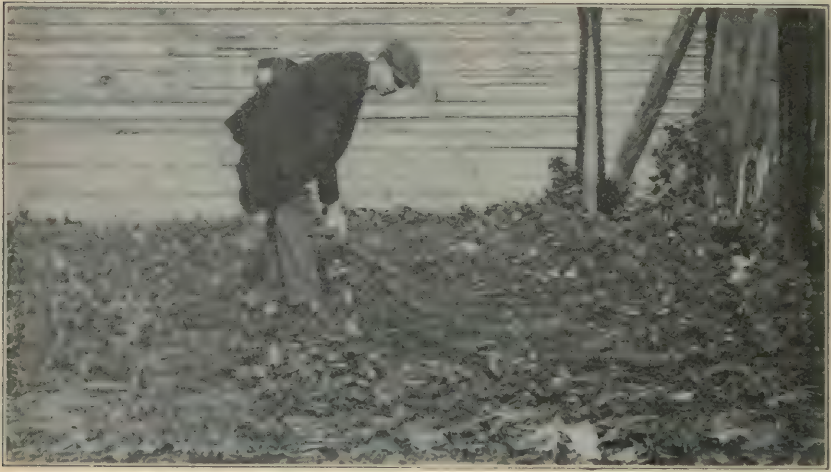

FIG. 6.—Corner of a vacant lot in southern Florida, showing mat of wild or volunteer sweet-potato vines badly infested by the sweet-potato weevil.

One form of injury is accomplished by the first-appearing weevils. After feeding on the leaves, stems, and vines enough eggs are deposited at the base of the vine to girdle it more or less completely, thus impairing its vitality before it is old enough to bear roots.

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[1] *Calonyction aculeata.*

[2] This includes *Ipomoea littoralis, I. trifida, I. trichocarpa, I. pandurata,* and *Jaquemontia tamnifolia.*

Many weevils undergo transformation within the base of the vine before the roots have attained much growth.

In regions where this weevil has long been established as a pest the careful housewife has learned to examine the sweet potatoes with a knife before cooking, cutting out the affected portions, otherwise they could not be eaten because of their bitter taste.

THE WEEVIL IS WINGED, BUT APPARENTLY TRAVELS SLOWLY.

At first sight the sweet-potato weevil appears to be wingless, but it has a pair of rather delicate-looking wings which it uses infrequently, only a few instances of flight having been recorded, in none of which the weevils flew far. If the theory that the weevil does not spread materially by flight is correct,[1] the insect will be easy to control, and the advantage which is thus offered toward its eradication may be readily appreciated by those who suffer annually from its ravages. Present knowledge indicates that its spread can scarcely be effected by flight, but is made possible through commercial movements of its food plant as previously described.

SEASONAL HISTORY.

The sweet-potato weevil passes through no very definite hibernation and is more or less active throughout the year in the Gulf States, unless restricted by low temperatures. Eggs, larvæ in different stages, pupæ, and adults may be found throughout the winter over the greater part of its range. Conradi states that little egg laying takes place during the three winter months, but the beetles are active on warm winter days, crawling rapidly about and feeding on stored roots with avidity.

In the field the beetles assume greater activity as soon as the young slips begin to appear in the seed bed. They feed first on the leaves and stalks of young plants, eating irregular holes in the leaves and making excavations in the stalks, which are particularly conspicuous near the surface of the ground. After the stalks reach sufficient size and begin to become woody, the eggs are deposited on the roots just below the earth line. The usual course taken by the female is to follow the vine to the roots and to deposit the eggs there. In soils subject to the formation of deep cracks in time of drought the eggs may be laid on the roots after they have reached the size of one's finger.

The young larvæ eat into the flesh of the potato, leaving an irregular mine or burrow lined with excrement. They burrow and feed throughout the root until their full growth is reached, then construct a more or less oval cavity at the end of the burrow, usually within one-fourth to one-half inch of the surface of the root, and there transform to pupæ.

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[1] Additional investigations to ascertain the extent of the flight of this weevil are being conducted, and will be continued in different localities under varying conditions. Possibly the insect may be distributed to some extent by winds, as in the case of the Colorado potato beetle.

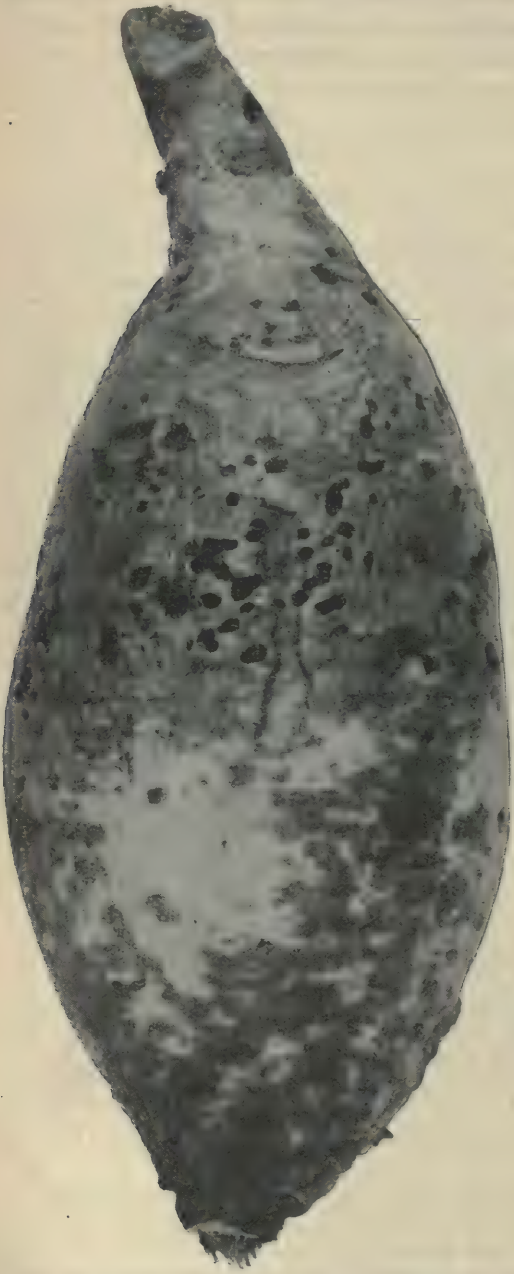

FIG. 7.—Sweet potato, nearly fresh, showing exit holes and feeding punctures of sweet-potato weevil toward stem. Note outer end scarcely attacked. Sample from Louisiana.

The adults emerge through irregular openings in the skin, many frequently issuing through the same hole. In figure 7 is shown a freshly harvested sweet potato in which exit holes and feeding punctures both appear. The characteristic severity of attack toward the stem end is well exhibited. As attack progresses and the roots become more seriously infested, especially in storage, they develop a tendency, provided they do not rot, to become quite dry, frequently imprisoning the weevils in the burrows and causing their death. Typical examples of infestation of this character are shown in figures 8 and 9, for comparison with the preceding.

Weevils in sweet potatoes left in the ground frequently perish in their burrows through fungus attack, especially should the soil be unduly moist, but they continue to breed in roots after these are too moist or dry for any useful purpose.

NOTES ON THE LIFE CYCLE.

Observations conducted by Mr. M. M. High in southern Texas show the possibility of a single beetle depositing upwards of 300 eggs. As many as 10 eggs have been deposited in a single night, and as many as 4 in three hours' time, the process of laying a single egg being quite protracted. The highest number deposited in one day of 24 hours was 18. Eggs are not laid in the feeding punctures, but in cavities especially prepared for them. These usually are bored at an angle of about 60 degrees, while the feeding punctures usually are perpendicular.

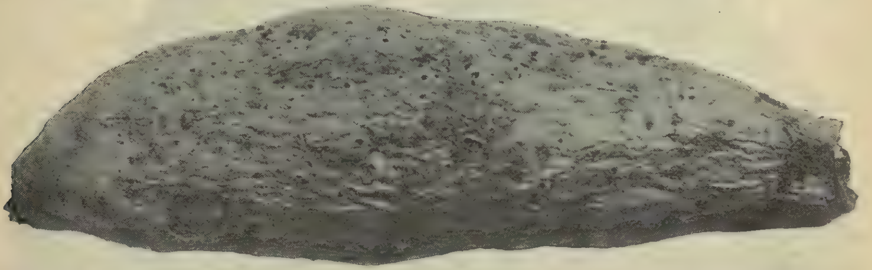

FIG. 8.—Sweet potato beginning to dry, showing punctures made by sweet-potato weevil, chiefly for food. Interior highly infested and root much shrunken.

Figure 8 shows a heavily infested sweet potato bearing on the outer and lower surface scars or punctures made chiefly by the adult weevil for feeding purposes. The interior contained many weevils, larvæ, and pupæ. On the upper surface of this root considerable shrinkage and few punctures or holes appeared. This shows how attack and consequent deterioration continue after infested roots have been harvested.

Transformation from egg to adult has been observed to last in warm weather about 30 days and in cooler weather it undoubtedly takes 42 days or longer. The entire life cycle from egg to egg in warm weather would consume about 5 weeks and in cooler weather 6 or 7 weeks. The pupal period has been observed to last 8 days and the egg period from 4 to 8 days according to temperature, which would leave from 2 to 4 weeks for the larva or active stage.

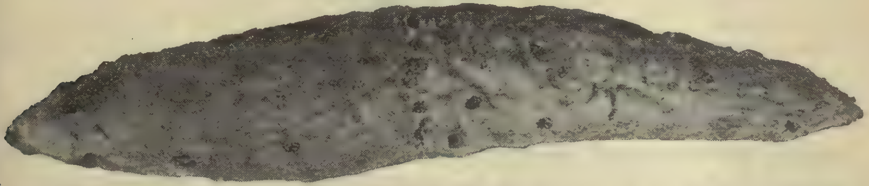

FIG. 9.—Sweet potato badly infested by sweet-potato weevil, decidedly dry, but showing break at middle where living larvæ, pupæ, and adults were found. Somewhat reduced.

NATURAL ENEMIES.

The sweet-potato weevil is, so far as known, remarkably free from natural enemies. It is unable to escape from roots when they become too dry and hard; when they become too moist and rots set in, the same effect is produced.

A mite affects the adult, but it probably has no material effect on the life of the weevil.

The red and yellow colors of this insect on the metallic blue background of the body are undoubtedly of a warning nature.[1]

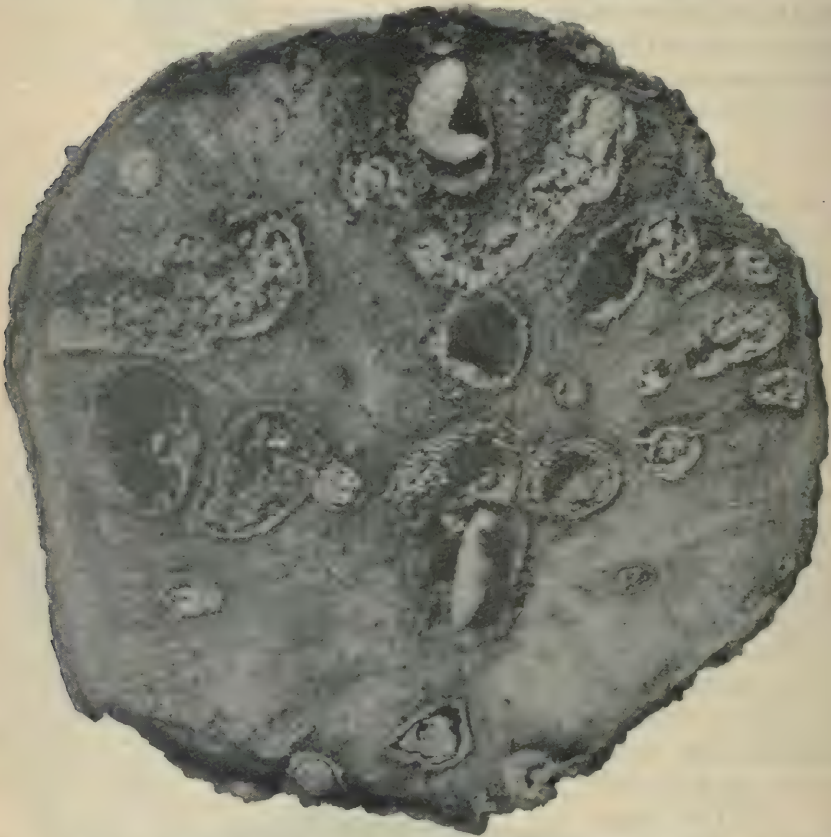

FIG. 10.—Cross section of sweet potato showing injury by sweet-potato weevil. Larva in burrow at top; pupa below; openings to tunnels elsewhere. Enlarged 3 diameters.

It seems probable that the sweet-potato weevil may be held in check by some natural enemies in its native home in the Orient, since comparatively little has been learned of the ravages of this pest in that region.

CONTROL.

In considering remedies for the sweet-potato weevil it should be remembered that the insect breeds exclusively on sweet potato and closely related plants such as morning-glory and bindweed, and that it does *not* breed on any other crop. The beetle, although provided with wings, is seldom seen in flight, and, being necessarily a slow traveler, its spread from one region to a distant one is effected by commerce. If it did not breed naturally on the weeds which have been mentioned, and especially on the seaside morning-glory, it would be comparatively easy to prevent absolutely its further distribution by instituting quarantine and other preventive measures. In any event quarantine measures will prove of the greatest value.

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[1] They resemble those of some predacious insects such as the great lebia (*Lebia grandis* Hentz), a most important enemy of the Colorado potato beetle, which is protected by its warning color from rapacious birds.

PREVENTING TRANSPORTATION FROM INFESTED TO UNINFESTED REGIONS.

Since the sweet-potato weevil, because of its limited powers of flight, can be distributed extensively only through transportation of infested tubers or propagation material, scrupulous care should be exercised by planters to see that propagation material is brought only from sections known to be free from the weevil.

Since investigations indicate that the weevil is capable of surviving the winter in nearly every sweet-potato growing section of the United States, the importance of prohibiting by legislation the shipping of infested sweet potatoes into districts where this insect is capable of becoming established can not be too greatly emphasized.

QUARANTINE REGULATIONS.

All States in which the sweet-potato weevil is known positively to occur have adequate crop-pest laws which permit the establishment of interstate and intercounty quarantines against insect pests. Quarantine measures have been adopted also by the States of Florida, Georgia, and Alabama, especially directed against the sweet-potato weevil. Except in Texas, the quarantine legislation prohibits the transportation of sweet-potato roots, plants, draws, and slips and of related plants from a weevil-infested locality to regions where the insect is unknown. Close cooperation with State and Federal authorities in the enforcement of these measures will accrue to the advantage of sweet-potato growers by reducing the annual losses from the attack of this weevil.[1]

It is especially urged that commercial plant growers provide for inspection whenever engaged in the shipment of seed potatoes and other propagation stock for planting, and that growers who purchase all or any portion of their planting stock insist that the shipment be accompanied by a certificate of inspection. This will prove a protection not only to the grower but to his entire neighborhood as well.

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[1] For information with regard to these quarantine laws growers are referred to the following publications:

For Florida, Quar. Bul., State Plant Bd. Florida, Vol. II, Oct., 1917.
For Georgia, Circ. 27, Ga. State Board Entom., Feb., 1918.
For Alabama, Circ. 37, Ala. Agr. Exp. Sta., Feb., 1918.
For Louisiana, La. State Board Agr. & Imm., Rule 21.

Concerted, decisive, and prompt cooperative action by growers, with inspectors and other State or Government officials employed in the enforcement of quarantine measures, may keep any community permanently free from this weevil, while every obstruction placed in the way of such enforcement favors the pest. Every grower should make sure that the weevil does not gain entrance to his neighborhood through any act of his, and should take pains to report to the proper authorities any suspicious injury to sweet-potato plants or tubers which may come to his attention. He should do everything that in him lies to keep the community, the county, the State, and the country free from this pernicious enemy of food production.

CLEAN CULTURE.

In addition to any remedies that may be employed, it is always advisable, in order to prevent the development and increase of this pest, to clean up infested fields promptly and destroy all vines, stems, tubers, and other remnants. Afterwards the ground should be deeply plowed or harrowed and kept free from volunteer potato and morning-glory vines.

Upon the thoroughness with which this work is done will depend immunity from further losses. In other words, upon promptness and scrupulous cleanliness depends a good crop.

USELESS SWEET POTATOES, IF NOT FED, SHOULD BE BURNED.

Every sweet potato should be carefully gathered from the field and the crop divided as nearly as possible into three lots: (1) Weevil-free roots; (2) roots slightly infested, for disinfection; (3) roots badly infested. The last, or culls, together with every remnant of an unsalable nature, should be gathered and fed to hogs, cattle, or poultry, after cooking them, to insure that no weevils may escape to reproduce their kind and restock the fields. If, however, they should prove to be unfit for stock, they should be burned with the vines immediately after harvest. This process can be facilitated by the addition of any ignitable material, such as straw, dry weeds, paper, or oil.

By careful attention to "hogging down" after harvesting, a grower who maintains a herd of pigs like those shown in figure 11 has disposed of his culls and "strings" at a good price, and has for a number of years kept weevil injury below 5 per cent in a region where it averages more than 50 per cent.

CROP ROTATION.

Rotation of crops is a necessary measure in the eradication of this pest; indeed, injury may be prevented to a large extent by the selection of the field for planting. This should be as remote as possible from old weevil-infested fields, and any other crop such as corn, cotton, tobacco, Irish potatoes, or a truck crop other than sweet potatoes may be grown between, as also on the infested area. This will lessen if not prevent infestation of the new field and is good farm practice, costing practically nothing. Where a natural barrier, such as a wood-lot or windbreak, stands between the old infested field and the new field it is of some value.

PLANTING THE NEW CROP REMOTE FROM THE SEED BED.

The practice of planting the main field of sweet potatoes as far as possible from the seed bed has been followed with excellent results by a number of large growers in regions where the weevil threatened the existence of the crop. It has been found that the heaviest losses were sustained where the seed potatoes were bedded in close proximity to the field in which the main crop was produced, and that when the seed beds were widely separated from the main field the damage was correspondingly reduced. One extensive grower, whose fields were located in a section subject to annual weevil injury exceeding 75 per cent of the crop, reported an average loss of less than 5 per cent since adopting this practice, in connection with that of "hogging down."

Fig. 11.—Part of a drove of pigs raised by a progressive ranchman of Brazoria County, Tex., as a useful adjunct to commercial sweet-potato growing.

Even better results may be reached through a practice of planting the slips or draws in a separate plat at a distance from the bed in which they are produced, and cutting the vines grown from these for the main crop at least 10 inches from the root. The main crop should, of course, be isolated from both the bed and the plat, which should be destroyed after their use for propagation has been served. The danger of carrying weevils to the main crop is thereby greatly reduced, since it is well known that any eggs or larvæ which might remain over will be left in the basal portion or crown of the vines.

DISINFECTING THE ROOTS.

Where sweet potatoes are not too badly damaged by the weevil they may be disinfected and the insects destroyed by means of carbon disulphid evaporated in tight receptacles. The use of this fumigant for sweet potatoes in storage bins has been recommended by several entomologists and there is no doubt whatever of its effectiveness with a proper dosage and under suitable conditions. The results obtained from its use both by growers and in experiment by agents of the Bureau of Entomology, however, indicate that under unfavorable conditions fumigated roots may fail to germinate or sprout, or may become subject to rapid and complete decay. The factors concerning this failure of effectiveness under such conditions appear to be primarily the high moisture content of the tubers, but include also the time of exposure, the condition as to curing, and temperature, with perhaps others as yet undetermined. These conditions are the subject of experiment at present, and complete data are not obtainable. Sufficient information, however, has been obtained to emphasize the necessity of a positive determination of these factors before the widespread use of carbon disulphid as a fumigant may be recommended unconditionally. Growers, therefore, are advised to proceed with extreme caution in the use of this chemical for the fumigation of sweet potatoes unless they are to be consumed immediately.

SPRAYING WITH ARSENICALS.

With the knowledge that the adult weevils feed on the leaves and stems of the slips, zinc arsenite and lead arsenate were tested as a remedy by Mr. High in southern Texas. In the first experiment made, where an actual count was possible, 80 per cent of the weevils were killed with zinc arsenite at the rate of 1 pound of powder to 40 gallons of water, with 15 pounds of cactus solution used as a "sticker" and "spreader."[1] Repeated experiments with this compound, and with lead arsenate in the same proportion, were made, showing that spraying would greatly lessen the damage if applied at the proper time. Another test was made with zinc arsenite, 1 pound to 30 gallons of water and 12 pounds of cactus solution, with the result that the infestation was only one-fourth as great on the sprayed as on the unsprayed plat. In another experiment at the same rate, 7 pounds of infested roots were counted from the sprayed plat, while on an unsprayed area of the same size 29 pounds were infested. In the last experiment reported, in the same proportion, 3 pounds of infested roots to the bushel were obtained on the sprayed area, while on the unsprayed check 16 pounds were infested to each bushel.

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[1] See "Cactus Solution as an Adhesive in Arsenical Sprays for Insects," Bul. 160, U. S. Dept. Agric. A formula substituting 3 pounds of soap to 50 gallons of water would be productive of practically the same results.

The spray should be applied for the first-appearing beetles; a second should be used and, in the case of heavy infestation, a third, at intervals of about 10 days.

Before setting out the plants they should be dipped in lead arsenate, 1 pound to about 10 gallons of water.

The precise value of the use of arsenicals as a spray against this weevil remains to be ascertained. Experiments are under way to determine this.

IMMUNE VARIETIES OF SWEET POTATOES UNKNOWN.

Observations indicate that the weevil attacks all varieties of sweet potatoes with equal facility, although the sweeter yellow varieties, called "yams" in the South, appear to be preferred. Some growers believe that earlier varieties suffer more severely than later ones, but this theory is not borne out by the experience of others, who assert that there is no marked difference. Observations conducted by Mr. High show that late-planted sweet potatoes, as a rule, do not harbor as great a number of weevils as occur in the case of early plantings, but that notwithstanding even late plantings may be completely destroyed.

Where sweet potatoes are grown in light, sandy soils which are not subject to the formation of deep cracks during dry weather, it has been learned that the deeper-growing varieties are less liable to infestation, because they are not so readily reached by the beetles.

In the many lots of sweet potatoes examined by the writer there is nothing to indicate that the weevil has different tastes from other insects, which as a general rule attack the choicest varieties in preference to those which are less palatable or more resistant to rots in store. Observations recorded in this country are practically the same as those noted by Tryon in Australia.

GENERAL INSTRUCTIONS.

Every case of infestation, whether a field, garden, or smaller area, should be thoroughly investigated from every point of view and all possible precautions taken to keep the sweet-potato weevil under control. The following general measures should be observed:

HARVEST PROMPTLY.

Prompt harvesting should be practiced. The roots, if found to be weevil-infested, should be fumigated promptly and thoroughly as soon as dug, before being placed in temporary storage prior to shipment. This will prevent further injury from weevil attack, which will practically cease at once.

AVOID SCATTERING THE WEEVILS.

Infested sweet potatoes should be sacked or barreled before being carried to the storage house or "pits" in order that unnecessary scattering of the beetles along the way may be prevented.

KEEP DOWN THE WILD PLANTS.

All morning-glories, whether wild or cultivated, especially the seaside morning-glory, and all volunteer sweet-potato plants should be kept down on the farm, as they furnish permanent breeding places for the weevil. Sweet potatoes should not be planted where these plants have been allowed to accumulate. Figure 6 shows the corner of a vacant lot in southern Florida in which wild or volunteer sweet potatoes accumulated and became heavily infested with weevils.

CARE IN STORAGE.

Storage houses and pits should be constructed at points remote from the sweet-potato field. All storage structures should be kept as dry as possible at all times, not alone because injurious attack by the sweet-potato weevil will be discouraged, but that storage losses from other causes, such as rots superinduced by weevil attack, may be decreased. They should be so constructed as to be available for fumigation, and to permit of inspection for weevil attack from time to time. Sweet potatoes stored in the manner shown in figure 12 can not be readily inspected or fumigated. These would require more thorough casing before treatment with carbon disulphid, since the sandy soil and the ventilation secured by means of pine needles would result in excessive gas leakage.

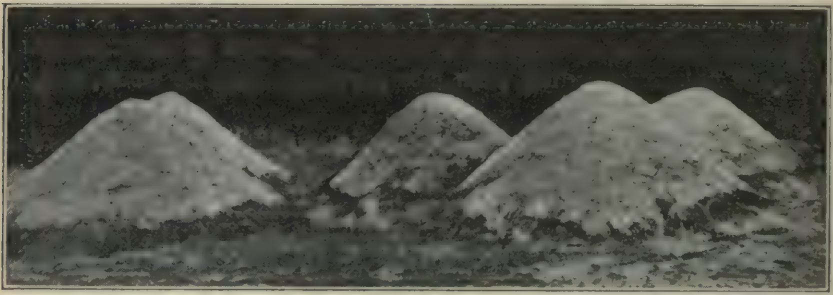

FIG. 12.—Sweet potatoes stored in "banks" on a Florida farm.

The use of a storage house of the nature illustrated in figure 13 is certain to result in the loss of the crop if used in infested districts. In this house the weevils were active during the month of January. It can not be fumigated, it permits the freezing of the crop during a "norther," and during warm weather becomes so hot that weevil activity is stimulated. The sweet potatoes stored here were more than 90 per cent infested by the sweet-potato weevil.[1]

Before placing weevily sweet potatoes in storage it is advisable to clean them thoroughly and then disinfect the storehouse by fumigation with sulphur, a process which is strongly advised by Dr. W. E. Hinds, entomologist of the Alabama State Experiment Station.

The fumes of sulphur are harmful to plant life, hence sweet potatoes treated with this fumigant would be valueless for planting, the gas destroying the germinating qualities of the roots.

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[1] The sweet-potato grower is referred to Farmers' Bulletin 970, "Sweet-potato Storage," by H. C. Thompson, issued in May, 1918, which may be obtained free on application to the Division of Publications. This bulletin furnishes information on the importance of the sweet-potato crop and full instructions as to the construction of storage houses for sweet potatoes.

COOPERATION.

Strict cooperation in the employment of the methods here advised in a single season will greatly reduce losses from the sweet-potato weevil. The weevil is, indeed, a species that might have been stamped out long ago if each grower had done his share toward destroying the insect or preventing its breeding on his own farm and had encouraged his neighbor to do likewise.

In several localities this insect has been eradicated by the employment of such simple methods as those advised or by abandoning completely the cultivation of sweet potatoes. The former step is necessary, the latter is an extreme measure, not at all necessary, because rotation of crops, as advised under the heading "Crop rotation," page 18, will accomplish the same object. Cooperation is not only the most necessary measure, but without it the control and eradication of the sweet-potato weevil will not be possible.

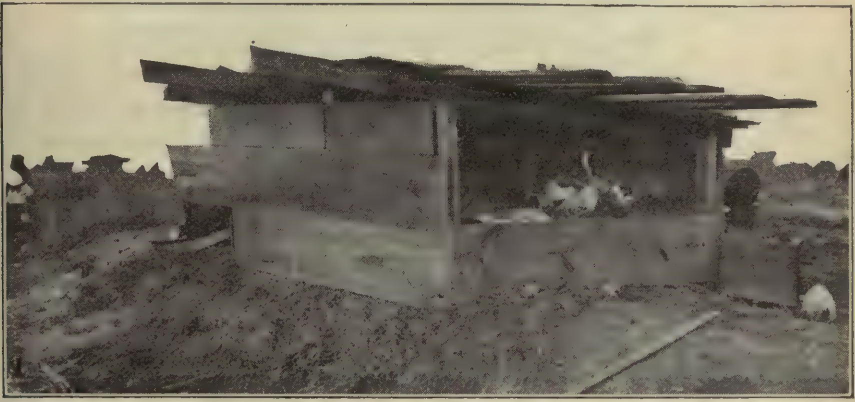

FIG. 13.—A poor type of storage house for sweet potatoes.

SUMMARY OF CONTROL MEASURES.

(1) Do everything possible to prevent the transportation of weevil-infested plants to uninfested districts.

Do not use for planting seed sweet potatoes, slips, or draws from weevil-infested localities, but obtain them from localities in which the weevil positively does not occur.

(2) Never use the same land for growing sweet potatoes year after year where weevils are present.

Rotate with cotton, corn, tobacco, Irish potatoes, peanuts, or any other profitable crop.

(3) Harvest promptly and thoroughly, gathering all tubers or roots. In infested regions sort tubers into three lots: (1) Those which are practically weevil-free, for storage; (2) those which are

moderately infested, for fumigation and early consumption; (3) those which are too badly weeviled, or otherwise injured, for food, to be cooked for stock or burned.

(4) Disinfect all weevily roots, wherever advisable and practicable (e. g., when soon to be eaten), with carbon disulphid or other fumigant.

(5) Destroy the weevils in badly infested and inferior roots by cooking and then feed to hogs, poultry, or cattle. Even if the infested roots are so badly damaged as to be bitter they may be fed if mixed with other feed for hogs.

(6) After cleaning up the culls, vines, remnants, and rubbish remaining in the fields after harvesting, burn them promptly and thereafter keep the fields clean at all times.

(7) Keep down volunteer sweet potatoes and all plants of the morning-glory family, whether cultivated or wild.

(8) Plant the new crop remote from the seed bed.

(9) Spray plants with arsenicals for first-appearing weevils on leaves and stems. Dip the slips and other propagation material into arsenate of lead before planting. Kill the beetles before egg laying begins and whenever they appear in numbers.

(10) Observe care in storage, keeping tubers dry at all times to prevent secondary injury from rots.

(11) All States in which the sweet-potato weevil occurs have adequate crop-pest laws which permit the establishment of both interstate and intercounty quarantines against this pest. Close cooperation with State and Federal authorities will be advantageous to growers in reducing losses from weevil attack. It is especially urged that commercial plant growers provide certificates of inspection for weevils when shipping plants or seed potatoes for planting, and that all growers who purchase planting stock insist that a certificate of inspection be furnished. Aid the enforcement of the quarantine laws.

(12) Finally, it is urged that growers carefully test such control measures as are here summarized as may seem most feasible or promising to them, and report their success, whether good, bad, or indifferent, that advice may be given against all unnecessary practices and a selection may be made of those which are the most essential for the destruction of the sweet-potato weevil wherever and whenever it may occur. In case of any other practices, also, reports are welcome.

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ALFALFA
on
CORN-BELT FARMS

FARMERS' BULLETIN 1021

UNITED STATES DEPARTMENT OF AGRICULTURE

ALFALFA, on Corn-Belt farms, if introduced in any considerable acreage, requires a great amount of labor at the most critical stage of the cultivation of corn.

This bulletin tells how the more successful Corn-Belt growers fit alfalfa into their cropping systems without interfering seriously with labor schedules.

This is done in the main by speeding up the haying operations and corn cultivation by the use of labor-saving implements and more efficient methods.

To some extent, the use of alfalfa for pasture serves to reduce the labor difficulties.

The methods of handling the alfalfa crop that have been worked out by some of the more experienced Corn-Belt growers are illustrated by several concrete examples of good management.

The material for this bulletin was obtained on 235 Corn-Belt farms on which alfalfa is grown successfully. (See fig. 1.)

Office of the Secretary
Contribution from the Office of Farm Management
E. H. THOMPSON, Acting Chief
Washington, D. C. July, 1919

ALFALFA ON CORN-BELT FARMS.

J. A. Drake, *Agriculturist*, J. C. Rundles, *Scientific Assistant*, and Ralph D. Jennings, *Scientific Assistant*.

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STATEMENT OF CONDITIONS.

Alfalfa is gradually assuming importance in the Corn Belt. In some localities where conditions are naturally favorable it is grown extensively, while in others less favorable its success has been limited. Progress in the introduction of alfalfa in general in this region has been affected very largely by three important factors:

1. Corn-Belt soils, as a rule, require inoculating and liming, and often expensive methods of preparation and seeding are practiced to insure success with alfalfa in the first attempts to grow the crop. When the soil is once inoculated, the crop is seeded more easily. On the average, also, alfalfa freezes out about once in every 5 years.

2. Clover, a long established crop, can be grown successfully with little trouble throughout the greater part of the region. This crop, unlike alfalfa, fits readily into the short rotations already established in the Corn Belt.

3. Alfalfa conflicts seriously with the corn crop, the first cutting of alfalfa coming in the height of the corn-cultivating season. As the acreage of alfalfa is increased, the labor problem of the average

Corn-Belt farm becomes more difficult, unless special means are adopted for relieving this situation.

THE MORE FAVORABLE VIEWPOINT.

Methods of growing alfalfa on Corn-Belt soils have been worked out throughout the region so that, as a rule, it is possible to grow the crop with profit, even though at considerable initial expense. After growing alfalfa successfully it is generally an easy matter to get a new stand, with about as much ease as red clover and often with the same inexpensive methods.[1]

Alfalfa should not be considered as competing with clover for a place in Corn-Belt agriculture. Each crop has its own place, and while red clover is distinctly the short rotation legume of the region, alfalfa insures an additional hay supply, and in many instances, permits of plowing under a large part of the clover in the rotation. In this way, alfalfa becomes an important factor in increasing the humus of the soil and in maintaining crop yields of the entire farm. Corn-Belt farmers in increasing numbers are growing alfalfa successfully, and are finding that it fills a valuable place as a means of soil improvement, and as a hay and pasture crop. Alfalfa produces heavier yields of hay per acre, and gives an all-summer pasture, which clover does not.

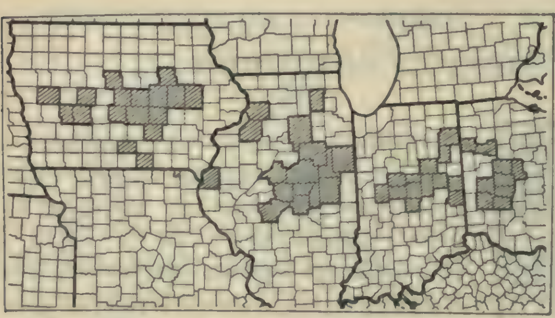

FIG. 1.—Shaded areas indicate parts of the Corn Belt visited in making the investigation on which this bulletin is based.

The labor conflict caused by the introduction of alfalfa is recognized as a serious problem, but is being overcome mainly by skilled management, by using better implements for corn cultivation, by using labor-saving equipment which speeds up the handling of hay, and by limiting and adjusting the corn and alfalfa acreages so that the regular labor of the farm can manage both crops.

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[1] For the details of how to grow alfalfa the reader is referred to the following bulletins which apply generally and with special reference to local conditions in the States included in the area:

Ohio, Circular 113, Bulletin 181; Indiana, Circular 36 (revised edition); Illinois, Bulletin 76; Iowa, Circular 3, Bulletin 137; Michigan, Circular 1, Bulletins 271 and 225; Wisconsin, Circular 35, Bulletin 259. For the foregoing apply to the experiment stations in the States mentioned. The United States Department of Agriculture issues Farmers' Bulletins dealing with alfalfa.

CROPPING SYSTEMS INCLUDING ALFALFA.

As yet, alfalfa is not commonly grown on Corn-Belt farms as a part of the regular rotation, but rather on separate acreages especially prepared and set apart for it. As a rule, this crop is not relied upon for the entire hay supply of the farm. The usual practice is to devote a certain acreage to alfalfa, and continue the customary rotation over the remainder of the farm.

The stand of alfalfa usually fails in about five years, often sooner, and the usual practice is to break up the field and grow one or two crops of corn to get rid of blue grass. During this time the farm generally is without alfalfa, but the year following, with some additional applications of fertilizer and manure, the same acreage is re-seeded and a stand is generally secured quite easily. The crop is then allowed to remain until such time as the stand begins to fail again. Where alfalfa naturally grows well, the crop may be rotated readily from field to field in a regular order. Even under less favorable conditions, if the fields of the farm have become thoroughly inoculated and the other requirements for growing the crop have been met, the re-seeding of alfalfa may be done usually with comparative ease, so that the seed is often sown in the small-grain crops, such as wheat, oats, rye, and especially in barley, and without losing the use of the land for a whole season.

SYSTEMS ON GRAIN FARMS.

Strictly grain farms usually have cropping systems peculiar to that type, consisting mainly of short rotations with a certain separate acreage for alfalfa. Throughout Illinois and Iowa most grain farms have rotations of from two to three years' duration. The most typical two-year cropping system is as follows:

First year, corn.
Second year, oats or wheat, with a seeding of clover to be plowed under
Four to six years on a separate acreage, alfalfa.

In this system clover is merely incidental and, regardless of the character of the stand, is plowed under in preparation for corn. Alfalfa is used to furnish practically all the hay needed, which releases the catch crop of clover for plowing under. Thus alfalfa serves a very useful purpose, and makes possible a cropping system of considerable merit for keeping up crop yields on the entire farm. The following is the most common three-year cropping system:

First year, corn.
Second year, wheat or oats, with seeding of clover.
Third year, clover.
Four to six years on a separate acreage, alfalfa.

The rotation in this system is apt to be somewhat irregular. Failure to get a stand or winterkilling of the clover is apt to disarrange the rotation. Soy beans might well be sown where the clover has failed and thus maintain the rotation, but usually the field is plowed up and put in corn or oats. Thus there is a constant tendency to shift to the two-year plan. The two-year plan is much more simple, and increases the grain acreage of the farm by approximately one-third more than the three-year rotation. With the three-year system the alfalfa releases the clover in the rotation for pasture or the clover may be plowed under to enrich the soil.

SYSTEMS ON GENERAL AND LIVE-STOCK FARMS.

Throughout the Corn Belt are a large number of general farms which keep considerable live stock, yet sell more or less grain and hay. Such farms, as a rule, follow four- to five-year rotations, which, however, are too short to include alfalfa, and necessitate growing this crop on a separate acreage. On a few farms in localities well suited to alfalfa the crop is run in a regular five-year rotation, allowing the alfalfa to stand only from two to three years before plowing it up. Such a plan is not advisable where growing alfalfa is a more difficult matter.

The more common four-year cropping systems with alfalfa are as follows:

(1) First year, corn.
Second year, oats.
Third year, wheat, with seeding of clover.
Fourth year, clover.

Four to six years on a separate acreage, alfalfa.

(2) First year, corn.
Second year, corn.
Third year, oats or wheat, with seeding of clover.
Fourth year, clover.

Four to six years on a separate acreage, alfalfa.

The first four-year rotation is found mainly on general farms which tend slightly toward a grain rather than a live-stock basis. In either rotation timothy may be seeded with clover, and the rotation lengthened to five years by allowing the clover and timothy to remain two years. This plan yields more hay and pasture, and makes it possible to increase the live stock of the farm. The addition of alfalfa in these cropping systems makes it possible to increase still further the live stock, and to sell relatively more hay or release a part of the clover in the rotation to be plowed under.

The second four-year cropping system with its larger acreage of corn is found usually on general farms which are devoted largely to live-stock production. The addition of alfalfa makes a well-balanced cropping system for a live-stock farm, and is especially adapted to hog farms. The alfalfa is valuable for the hay it adds, so that the clover in the rotation may be released for hay or pasture, and in addition, it furnishes an all-summer emergency pasture, which can often be used to good advantage. The usual tendency when alfalfa is added to the cropping system on general farms is to increase the live stock; 87 of the 235 farms visited had increased the amount of live stock materially, the increase ranging from 12 to 25 per cent.

SYSTEMS ON SPECIAL HAY AND LIVE-STOCK FARMS.

In southwestern Ohio and western Iowa, as well as in other restricted areas throughout the Corn Belt, alfalfa can be seeded readily with the small grain crop of the rotation. Usually where alfalfa is run as a part of the regular rotation, it is necessary to follow one of at least five years' duration, and in a few instances it was found in a system of this kind as follows:

First year, corn.
Second year, oats or barley, with a seeding of alfalfa.
Third year, alfalfa.
Fourth year, alfalfa.
Fifth year, alfalfa.

Except in localities which are very favorable for the growing of alfalfa, the five-year rotation is too short to permit the alfalfa to remain long enough for the farm to get the full benefit of the stand before plowing it up; but where conditions are especially favorable, there is very little expense in reseeding alfalfa, and a five-year rotation may well be practiced. It is evident that such a rotation is highly satisfactory from the standpoint of building up the soil of the entire farm. It likewise affords considerable hay and pasture because three of the five fields are devoted to the alfalfa crop. Usually, however, there is a tendency to run alfalfa in longer rotations of from six to seven or even eight years' duration. The Wing farm of Champaign County, Ohio, is one of the best examples of a farm of this type. Similar farms are found here and there throughout the Corn Belt. The rotations on farms of this general type are usually as follows:

First year, corn.
Second year, corn.
Third year, barley, with seeding of alfalfa.
Fourth year, alfalfa.
Fifth year, alfalfa.
Sixth year, alfalfa.
Seventh year, alfalfa.

This arrangement makes alfalfa the dominating crop of the farm. Four of the fields out of the total seven are producing alfalfa hay each year, one field is devoted to getting a stand of alfalfa with a nurse crop of barley, and two fields are devoted to corn. This type of farm is extreme in its make-up and is suited only to localities in the Corn Belt which are especially well adapted to the production of alfalfa. It is also important that a large number of live stock be kept to consume the hay or at least the hay that is not salable on the market. Usually on such farms the operator specializes in winter feeding of lambs or beef cattle, lamb feeding being the enterprise which generally prevails. Where it is undesirable to carry on feeding operations on a large scale with this system of farming, enough live stock may be kept to consume the waste or second-class hay, and the first grade hay may be sold on the market.

Where alfalfa is made the most important crop of the farm system the chief difficulty is in meeting the labor requirements. A relatively large force of men is needed when the alfalfa hay is to be handled. It is difficult to keep these men profitably employed at other times, especially during the winter. If not employed the year round, it is generally necessary to depend on transient labor or the hiring of extra hands, neither of which can be relied upon generally throughout the Corn Belt sections. In some instances it was thought advisable under the circumstances to plan extra work for winter, even though unprofitable, in order to keep a sufficient crew to handle the alfalfa hay. Besides the labor difficulties, such a farm as a general proposition for the average farmer, as a rule, is undesirable.

THE LABOR CONFLICT BETWEEN ALFALFA AND CORN.

The first cutting of alfalfa, throughout the central Corn Belt, comes, as a rule, during the first nine days of June, the extreme dates ranging from May 25 to June 20. (See fig. 2.) This wide variation is due principally to difference in seasons. It will be noted further by reference to figure 2 that the first cutting of alfalfa comes in the midst of the cultivation of corn. Sometimes, by carefully planning the time of planting corn, the alfalfa may be cut just before or immediately after the first cultivation. Alfalfa must be cut within a period of about 10 days, however, in order to avoid injury to the second crop. and as this period shifts somewhat from year to year, it is difficult to reckon a definite time for the first cutting. As a result it generally happens that this cutting conflicts directly with the first or second cultivation of corn.

Not infrequently also the weather is very unfavorable for curing hay when the first crop must be handled, in which case haying is delayed and the labor is increased. Wet weather at such times retards the cultivation of corn. Under such conditions when a large acreage of alfalfa must be handled and there is also a large acreage of corn to be cultivated the work becomes especially difficult to handle.

The second cutting may vary from July 1 to July 31, but it usually comes between July 10 and July 19 (see fig. 2), conflicting with oats

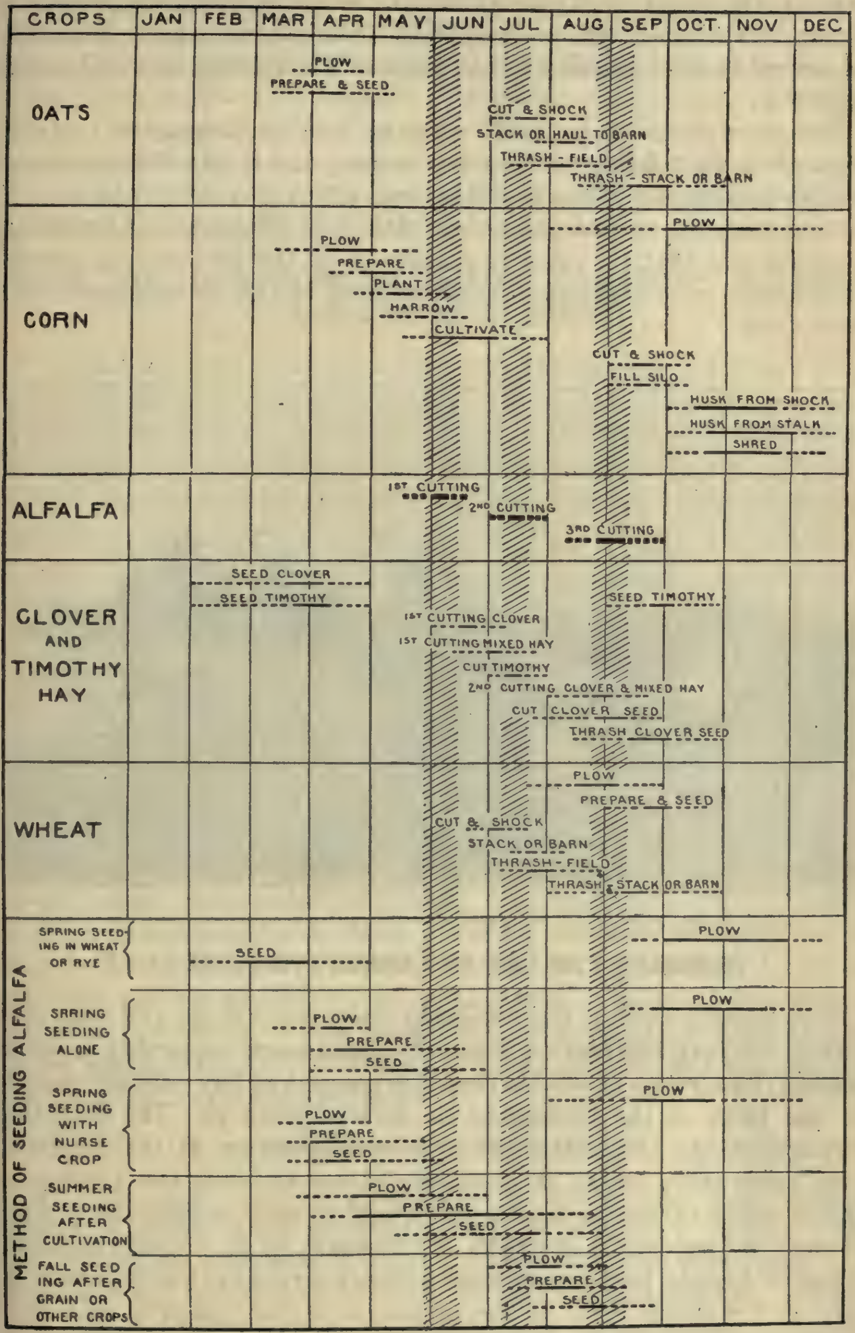

FIG. 2.—Seasonal distribution of labor on the principal farm crops of the central Corn-Belt region. The continuous lines show the average time in which each operation is usually done; the dotted lines show the extreme limits within which these operations may occur. By following shaded perpendicular bands one may note points of conflict between alfalfa and other crops. Data from 237 farms.

harvest, thrashing wheat, or cutting timothy hay, each of which is a comparatively short job. The yield for the second cutting is usually considerably lighter than for the first, and the weather is usually more favorable.

The third cutting, generally coming late in August or early in September, is still lighter than the second, and is handled with even less labor conflict. Thus it will be seen that labor difficulties in connection with the second and third cuttings of alfalfa are of little consequence and that the labor requirements of the first cutting are the vital factor in determining the acreage of alfalfa to be grown on a given farm.

FIG. 3.—While putting up the first cutting of alfalfa the corn cultivator often must stand idle in the field.

HANDLING THE HAY AND CULTIVATING THE CORN.

The amount of hay the available crew can handle and still take care of the corn cultivation is usually much more important in determining the acreage of alfalfa than the amount of hay actually needed on the farm or the income to be derived from it. The fact that throughout the Corn Belt the first cutting comes at the height of corn cultivation makes it necessary either to limit the acreage of alfalfa, since otherwise the farmer would have to reduce the acreage of corn in proportion as alfalfa is increased, or to provide sufficient labor to handle both operations without serious interruptions. As corn is the staple crop of the region, it is only natural that most growers choose to limit the acreage of alfalfa rather than that of corn.

As a rule, alfalfa is grown on the farms of the Corn Belt in areas from 5 to 15 acres in extent. Within these limits and even up to 25 acres farm operators are able to meet the difficulties in managing the crop in connection with the crop systems already established without hiring much outside labor, but when alfalfa is increased to 35 and 40 acres considerable extra help is needed. In proportion as the crop is pastured the usual small acreage of alfalfa may be enlarged without making it necessary to increase the farm crew.

WAYS OF OVERCOMING LABOR CONFLICT BETWEEN ALFALFA AND CORN.

The labor conflict between corn cultivation and the first cutting of alfalfa may be lessened in several ways. On well-managed farms an effort is constantly being made to keep the work well up with or a little ahead of the season. Fall plowing is done in order to lessen the work in the spring, and under favorable conditions, the spring operations are begun early. After planting the corn crop the spike-tooth harrow is used two or three times to get the ground in good condition and keep down the weeds. This work can be done rapidly, and it postpones the date when it will be necessary to begin cultivation. In the meantime, there is usually an opportunity to handle the first cutting of alfalfa hay. Sometimes it is necessary to carry on both operations at the same time, cultivating corn in the forenoon, when little can be done in the hay field except the mowing. In this way very little time is lost.

> IN GENERAL, the labor conflict between the alfalfa and corn is recognized throughout the region as being serious, but considerable progress is being made in overcoming this difficulty by the adoption of better methods and more improved machinery and equipment.

THE TWO-ROW CULTIVATOR.

The use of the two-row cultivator is one of the most effective means of relieving the pressure caused by this labor conflict. This implement has been slow in gaining recognition, but where used with ordinary skill and reasonable care, its value is indisputable. With it one man and three horses can do practically as much as two men and four horses with one-row cultivators. Farm records taken on 237 Corn-Belt farms in Ohio, Indiana, Illinois, and Iowa show an average of 6½ acres cultivated per day with the one-row cultivator, with individual records ranging from 5 to 8 acres per day. Thirty-three records on the use of the two-row cultivator show an average of 13 acres per day, with individual records ranging from 10 to 15 acres per day. In general these implements, where they receive a fair trial, are giving entire satisfaction. (See fig. 4.)

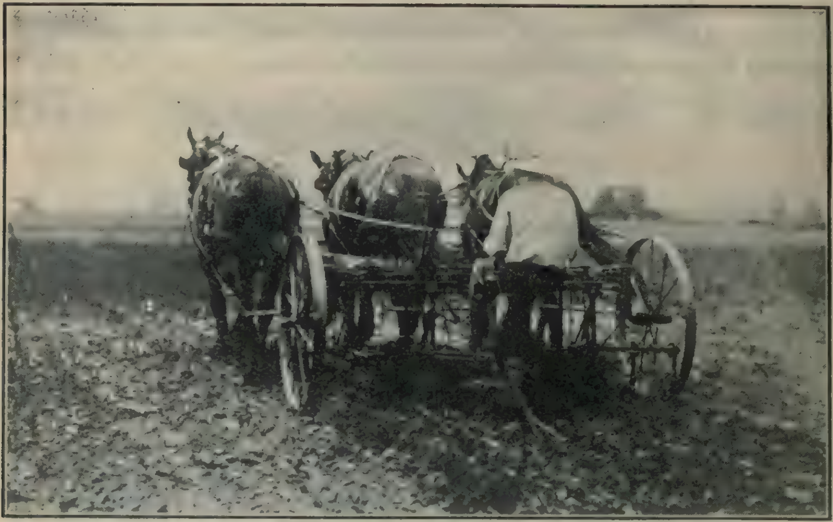

FIG. 4.—A two-row cultivator makes it possible to rush the corn cultivation and get it out of the way, or it makes it easier to make up the time lost in handling the alfalfa crop.

If the need of cultivation is delayed by harrowing, and the corn is allowed to grow a few days before cultivation starts, the two-row cultivator can be used for the first cultivation as well as later. Generally both one- and two-row cultivators are used on the same farm, but on 10 of the farms visited the cultivation was done entirely and satisfactorily by two-row cultivators.

LABOR-SAVING METHODS OF HANDLING HAY.

The efficiency of the methods used in handling and curing the hay is of great importance in fitting alfalfa into the cropping system. A study of the haying operations on 235 Corn-Belt farms shows that four fairly distinct methods are in common use in handling alfalfa throughout this region. From the standpoint of actual time consumed and labor required, these methods vary greatly, as is shown by the following table, based on the first cutting and a yield of 1½ tons per acre:

Time and labor required in handling and curing alfalfa hay by different methods.

[First cutting, yield 1½ tons per acre.]

Method.	Number of farms.	Average acres of alfalfa per farm.	Hours of labor per acre.	
			Man.	Horse.
1. Cut, rake, cock, haul, and put in barn, hay pitched by hand	111	14.02	8.66	7.65
2. Cut, rake, haul from windrow, and put in barn, hay pitched by hand	65	13.34	7.01	8.25
3. Cut, rake with side delivery, put in barn, hay loader used in loading	54	12.66	5.70	7.54
4. Cut, rake, haul to stacks in fields with buck rake, hay stacked with stacker	2	38.25	4.80	5.64
5. Cut, rake, haul to baler with buck rakes, then hauled to barn on wagon	3	22.7	9.56	9.96

From method 1 to method 4 there is a gradual decrease in the labor required, the average amount of man labor required per acre by method 4 being only a little more than half that required by method 1, if results obtained on the two farms using the method 4 may be taken as normal. Method 5 includes baling in the field, and is not comparable with the others, but it is worthy of note that on the three farms following this method, the combined operations required only about one hour more of man labor per acre than method 1. (See fig. 5.)

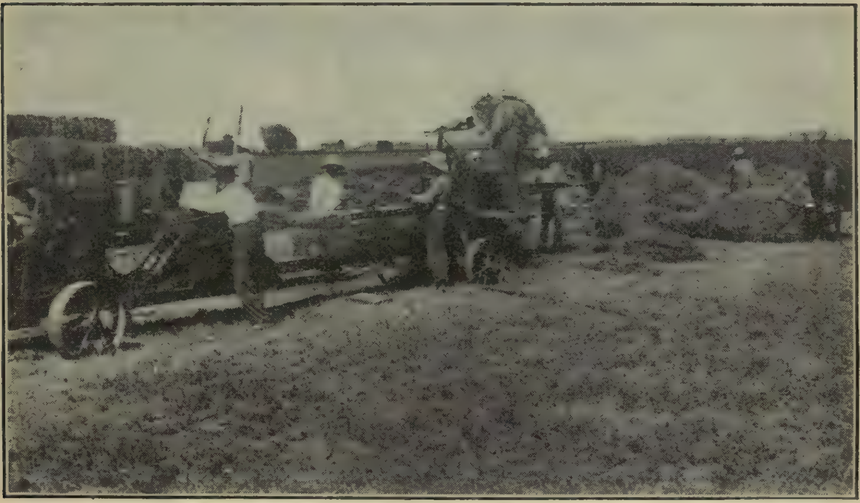

FIG. 5.—Baling from the cock requires a little more time than putting the hay in the barn loose, but if it is to be baled at all considerable time and labor are saved by baling in the field.

HANDLING BY HAND.

The first method is most common; it was practiced on 111 of the 235 farms visited. Because of the great amount of hand labor involved in cocking and in pitching the hay on to wagons by hand, method 1 requires the most time and labor. Many of the growers visited did not have acreages large enough to justify the purchase of labor-saving equipment, while others with large acreages clung to the belief that cocking the hay and handling it by hand was a necessary step.

Hand handling without cocking.—Method 2 is practically the same as method 1, with cocking omitted. The difference between these two methods in labor required is practically the time necessary for cocking. The saving in time by methods 3 and 4, as compared with 1 and 2, is due largely to the better use of haying machinery and to the fact that cocking and pitching by hand are entirely eliminated.

Whenever the speeding-up process becomes desirable, pitching the hay on to the wagon by hand must first be abandoned. Two men pitching by hand will put on wagons ordinarily but 2 to 3 tons per hour, whereas by some of the other methods, from 3 to 4 tons of hay may be placed on wagons with much less man labor. (See fig. 6.)

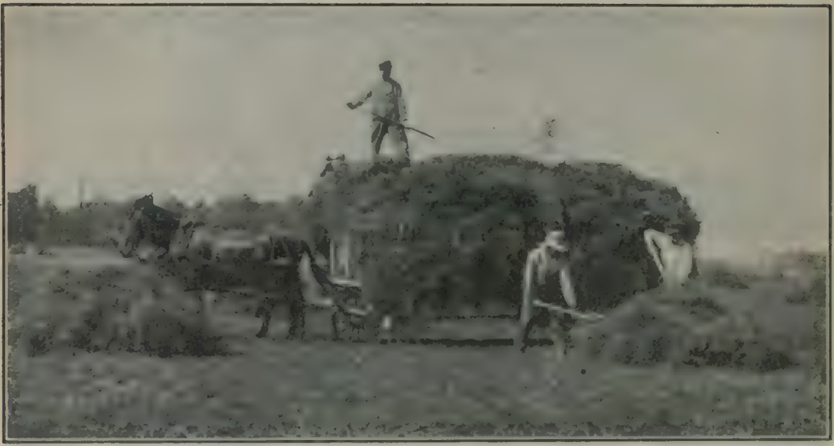

FIG. 6.—Pitching hay on to the wagon by hand, though slow and laborious, is still practiced on the larger number of farms.

By avoiding cocking, the process of haymaking is considerably shortened and much time is saved. Estimates taken on 111 alfalfa farms, with an average yield of 1½ tons per acre, gave an average of about two-thirds of a ton as the amount one man will cock in an hour, and 4½ acres as the amount one man will cock in a day of 10 hours. Where 20 to 25 acres of hay are to be put up, the cocking requires from four to six days of labor for one man or a full day's work for from four to six men.

Under the more common methods employed in the Corn Belt, especially methods 1 and 2, hay is generally allowed to cure in the swath one and one-half or two days after cutting, when it is usually raked and cocked. (See fig. 7.) Hay cured mainly in the cock is usually of excellent quality and color, hence is in demand on the market, but in many cases, the better quality thus produced may not justify the extra labor required.

HANDLING WITH SIDE-DELIVERY RAKE AND HAY LOADER.

Method 3 is much more rapid and far less laborious than either method 1 or method 2. The hay is usually allowed to lie in the swath one day after cutting, when it is raked into windrows by the side-delivery rake. If weather conditions are good, the hay is allowed to remain in the windrows another day and then is taken up from the field by means of a hay loader. In case of rain the windrows are left unmolested until good weather comes again, when the hay, while still wet, is turned by the use of the side-delivery rake, and after drying a few hours in this condition it is ready to be loaded on wagons and taken to the barn. This method saves time and much labor.

FIG. 7.—With alfalfa the tendency is to use methods which include cocking.

STACKING WITH BUCK RAKES AND STACKER.

The method of curing and handling the hay preparatory to the use of a buck rake or sweep rake varies greatly. As a rule, it is not satisfactory to take the alfalfa hay out of the swath with the buck rake, as is sometimes done with mixed hay or timothy. In most cases the alfalfa hay is cured in the field and raked into windrows with the ordinary dump rake. The hay may be bunched in the windrow by the dump rake, cocked by hand, or taken directly from the windrows by the buck rake without any further preparation. In some instances, the side-delivery rake is used for making the windrows, which are sometimes made larger by throwing two together. The side-delivery rake makes a looser windrow than does the ordinary dump rake, and thus the hay can be raked sooner after cutting than with the dump rake and can be cured more thoroughly in the windrows, which improves the quality of the hay and to a great extent prevents the loss of leaves. In some instances the curing is done largely in the cock, prior to hauling.

LABOR-SAVING IMPLEMENTS.

LABOR-SAVING implements are a most effective means of speeding up hay-making operations. As haying methods in general are improved, and as special equipment is used to better advantage, labor difficulties arising from the introduction of alfalfa into the cropping system may gradually be overcome, and increasing acreages can be grown without serious interruptions to the regular operations of the farm.

THE BARN FORK AND HAY SLING.

The hay fork, either alone or in combination with the hay sling, is a great factor in speeding up haying operations. On many farms two double-harpoon forks are used instead of one, thus further reducing the time required for unloading. Usually on each fork is a pulley through which a rope passes with a double hitch, and as the pull is exerted, the forks, one at each end of the load, carry with them a layer of hay from the entire load. On some farms the forks are attached to the end of the hay rope by two chains or ropes, each from 3 to 5 feet in length. This arrangement serves the same purpose as the more complicated equipment just described.

In addition to using two double-harpoon forks, Mr. J. A. Cochran, of Allen County, Ohio, uses a hay sling for each wagon, which he spreads on the hay rack and on which the hay is loaded. After unloading has proceeded to a point where the remainder of the hay can be taken up at one pull, the sling is attached to the hay rope and the rest of the load is carried up at one operation. Thus no time is lost in cleaning up by hand, as is necessary when the entire load is removed by the hay forks alone. Used in this way in connection with hay forks, the sling makes it possible to unload hay very rapidly.

Mr. S. S. Kooser, of Storey County, Iowa, uses the hay sling alone very effectively in putting hay in the barn. His alfalfa field is only a quarter of a mile from the barn, and buck rakes are used for hauling the hay from the field. The hay is taken up from the end of the barn by the hay sling. The sling, in fact, is necessary in this case because the buck rake leaves the hay too loose to be handled by the average hay fork. To accommodate the sling to this work, about 6 inches of earth is dug away, making a depression the size of the sling, in which it is spread. The buck rakes are driven up to the point where the hay is directly over the sling, then the teeth are let down and the rake is backed off, after which the sling is attached to the end of the hay rope and the entire load of the buck rake is taken up at one pull. The estimate given in the records taken on this farm is a little over 4 hours of man labor and 4¼ hours of horse labor required to put in the barn an acre of alfalfa, allowing 1½ tons per acre. This estimate of the labor requirement is even lower than the average for method 4, the best method described on page 13.

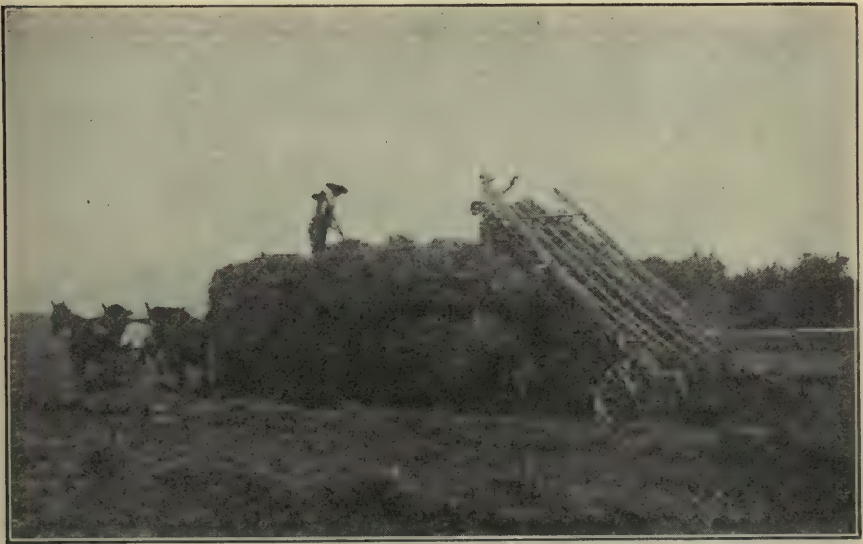

FIG. 8.—The elevator, web, or drum loader damages properly cured alfalfa hay very little more than does the loading by hand, and places on wagons from 3 to 4 tons of hay per hour.

SIDE-DELIVERY RAKE AND HAY LOADER.

A rather general prejudice exists against the use of the hay loader among alfalfa growers in the Corn Belt. The common belief is that this implement thrashes off and loses too great a proportion of the alfalfa leaves. The loaders on the market, however, are of two different types. The objection, in a great measure, holds good for one type but is not so applicable to the other. Taking into consideration the rapidity with which the hay can be handled, a loader of the better type is highly desirable where alfalfa is grown in considerable acreages. (See fig. 8.)

The greater part of the alfalfa hay of the Corn Belt is put in barns, and comparatively little of it is stacked out. Hence the importance of the side-delivery rake and hay loader, as this equipment offers about the most satisfactory means so far devised for putting hay into the barn rapidly under average conditions.

The web or elevator type loader.—The hay loader shown in figure 8 is known as the "elevator," "belt," "web," "cylinder," or "drum" type. This type in general takes up the hay by means of revolving cylinders or drums with flexible wire claws or spurs, and elevates it by means of carriers made of belts or chains and cross slats. Occasionally a web or canvas is used for this purpose. Some manufacturers are now making this type of loader with a solid bottom in order to save more of the shattered leaves of the hay. This type of implement makes it possible to handle the hay rapidly with very little damage from the loss of leaves. It is the general testimony where these loaders are in use that the hay is not injured materially, but it is conceded that a little more work is required in loading with them than with some of the other types which push the hay farther up on the load.

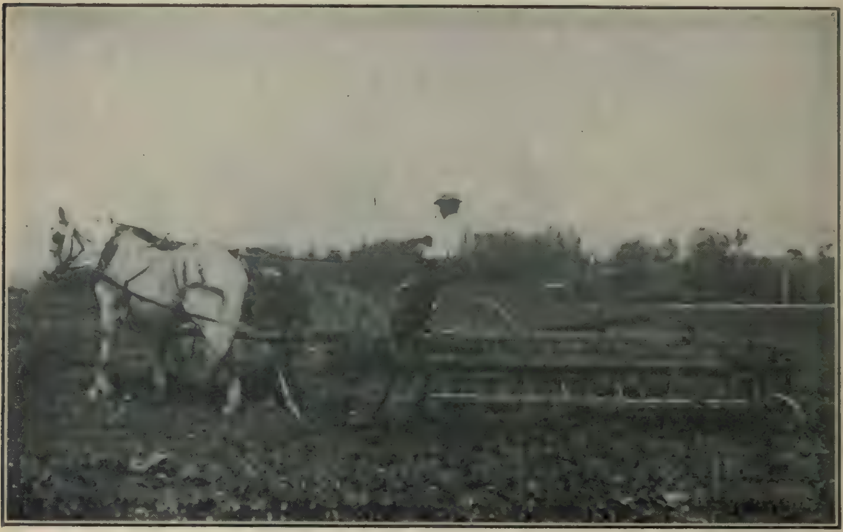

FIG. 9.—The rotary type of side-delivery rake leaves the hay in good condition for curing in the windrow.

That these loaders may be used to the best advantage, the hay must be cured properly and raked into medium-sized windrows. When only partially cured it should be raked with a side-delivery rake, which leaves the hay in a loose, twisted windrow through which the air can circulate easily. In order to leave the hay in the best condition for curing, the side-delivery rake should be of the rotary rather than the hay tedder type. Figure 9 shows a side-delivery rake of the type generally recommended for use with the web or elevator loader.

The rake-bar type loader.—The rake or rake-bar type of loader, while considered a good implement for putting up clover or mixed hay, is not so well suited to handling alfalfa. This loader is essentially a series of rake-like claws and flexible wire spurs on two sets of wooden bars, each set of bars moving alternately up and down along an inclined plane. The claws gather the hay from the ground, and the bars in their sliding action push it gradually up the inclined plane until it falls upon the load. This type of loader subjects the hay to a process of beating or flailing in this upward movement. In the case of well-cured alfalfa, this action thrashes off large quantities of leaves. It is generally recognized that it requires less labor to handle hay on the load when elevated by the rake type than when the web type is used. The rake type pushes the hay further forward on the load, and thus saves considerable labor for the men who are loading. A web loader keeps two men very busy, whereas, with the rake type, one man, when the occasion demands, can do very well at loading alone. This feature is to be considered in choosing a loader for handling hay other than alfalfa. Figure 10 shows a loader of the rake type being used, perhaps inadvisedly, in taking up alfalfa from the swath.

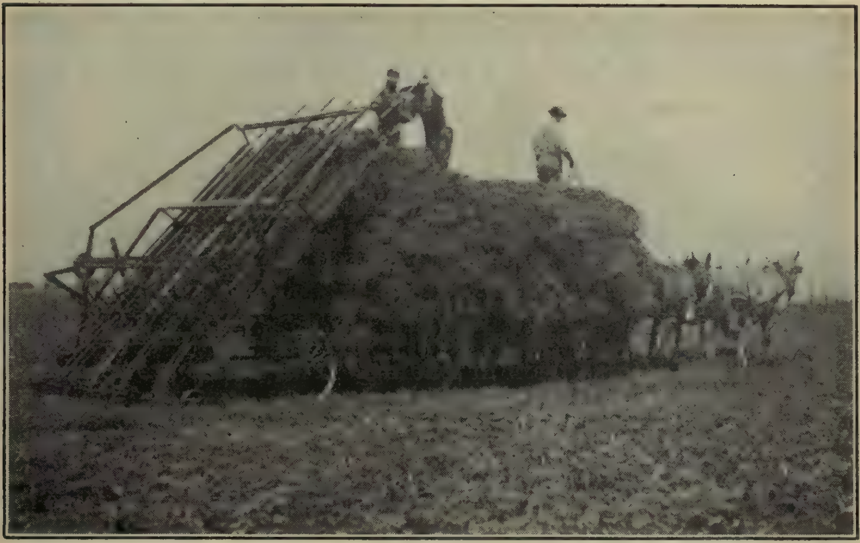

FIG. 10.—The rake or rake-bar type of loader is not considered a good implement for loading alfalfa hay, on account of the loss of leaves.

On a number of the farms visited methods of handling alfalfa hay with these outfits have been well systematized. The plans vary slightly, but in general are similar. The method practiced on a farm in Champaign County, Ohio, is especially worthy of consideration. It has been worked out with great care by the owner of the farm, Mr. J. C. Greer, and is given herewith in detail.

AN EXAMPLE OF GOOD HAYING METHODS.

The hay is raked with the side-delivery rake in the forenoon of the next day after cutting and is left in the windrow usually 2 days, or until ready to be put into the barn. In case of rain, these windrows, while still wet, are turned with the side-delivery rake. The hay is taken up out of the windrow with an elevator or web loader and is taken up into the barn by the use of two double-harpoon forks fastened to the end of the hay rope by two chains each about 3 feet in length.

This farm at present has 24 acres of alfalfa. This acreage is cut with a 6-foot mower in 1¾ to 2 days of 10 hours each. It is raked with the side-delivery rake in three-fourths day or 7½ hours, and if it is necessary to turn the hay on account of rain the turning is done also with the rake in the same length of time.

The yield of hay for the first cutting is on the average 1¼ tons per acre, or 30 tons on the 24 acres. This amount is taken up out of the field and put in the barn in a fraction less than 10 hours, or at the rate of 3 tons per hour. The field is close to the barn, not over one-fourth mile distant, and little time is lost in hauling.

A crew of seven men and eight horses with two wagons is used for hauling. The distribution of the crew is as follows:

Two men in the barn to mow away the hay; one man on each wagon to drive to and from the field, set the fork in unloading, and work on the load in the field; one man to drive the team on the fork at the barn; one man in the field who helps load each wagon in turn, and one man who drives the 4-horse team in loading. Two horses are used on the wagon to draw the hay from the field; two on the fork at the barn, and two in the field to change from one wagon to the other in making up a 4-horse team.

In order to get this crew together, it is necessary to get three men and two horses from a neighboring farm for one day while putting the hay in the barn.

In good weather haying, from start to finish, is over in 4 days. It keeps one man and his team out of the corn field and away from the job of cultivating for two days while mowing, and another man and his team from the cornfield a day and a half to rake, and in case of a rain a day and a half to turn the windrows.

The entire farm crew of three men and six horses must quit the cornfield for one day when the hay is put in the barn, and another full day to help the neighbor in return for the use of his crew of two men and two horses.

Thus a crop of comparatively large acreage for the Corn Belt is handled on this farm with little disturbance to the cultivation of corn, which would not be possible without the use of improved machinery.

Low-down wagons and hay loader.—The wagons used on this farm are suited to haying, being low, with broad wheels to prevent cutting up the field, and were made up at an outlay of about $35 each, complete. The running gears were from old farm wagons on which the wheels had given out. The low iron wheels were purchased for $17.50 per set. The racks were made on the farm at a total cost of about $10 per rack. These racks are 16 feet long and 7 feet wide when opened for hay. On each side and end is a board 1 foot wide held by six hinges. When these are lifted upright and fastened to the end gates, a tight box 1 foot high, 5 feet wide, and 16 feet long is formed.

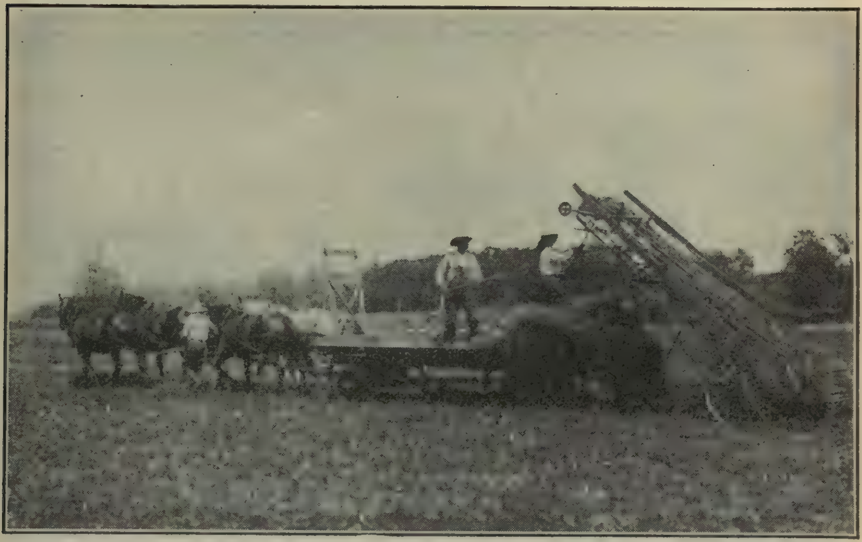

FIG. 11.—A low-down, broad-tired wagon and hay loader as used on a farm in Champaign County, Ohio.

The hay loader used on this farm, shown in figure 11, was purchased four years ago for $65, but at this time (1919) it would cost considerably more. The side-delivery rake purchased at the same time cost $50, but this also would be higher now.

The effective combination of the low-down wagons and loading equipment has been obtained with comparatively small outlay of money. This outfit has been a very important item in fitting a good acreage of alfalfa into the cropping system of a Corn-Belt farm. In fact, with this outfit it would be possible to increase materially the acreage grown on this farm without seriously affecting the labor schedule.

THE BUCK RAKE AND HAY STACKER.

The buck rake or sweep rake is found in the Corn Belt principally on farms which have large acreages of hay, but there is little doubt of its value in handling smaller acreages as well. This implement is of great value in speeding up the haying operations and in reducing the amount of hand labor necessary.

The buck rakes in use are of different sizes but are generally of the three- or four-wheel type. This type has an arrangement for elevating the teeth after the load is taken on, which keeps the hay from dragging on the ground. Generally these rakes are so made as to permit folding up when it is necessary to move them from field to field through narrow gates.[1]

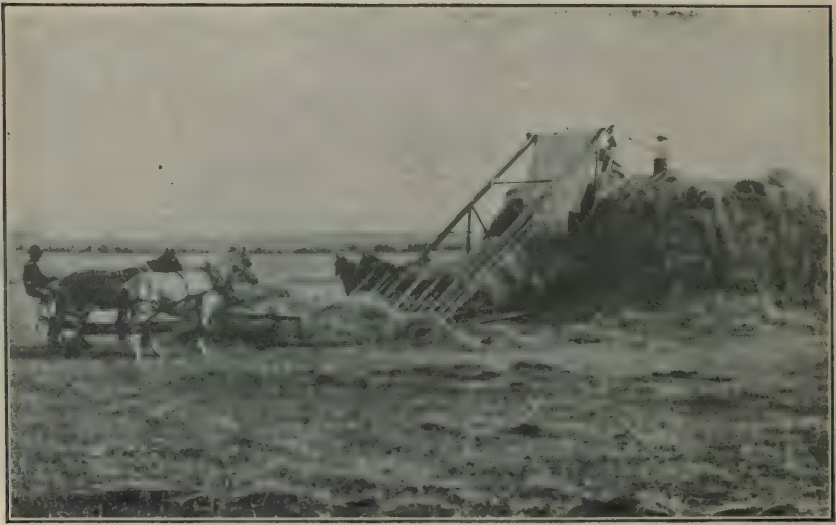

FIG. 12.—Type of stacker and buck rake in use on one of the alfalfa farms in Champaign County, Ohio.

In the Corn Belt the handling of alfalfa hay with buck rakes is usually confined to the large acreages, where it is necessary to stack most of the hay in the field, but not infrequently these rakes are used to good advantage in putting the hay in the barn or hay shed where the haul is not more than about one-fourth of a mile.

In using the buck rake in stacking hay in the field some form of hay stacker is essential. A number of devices of this kind are on the market, and several efficient types may be made on the farm.

Buck rake and stacker on one farm.—An exceptionally good example of the use of buck rake and stacker is found on the farm of H. C. Rogers, Champaign County, Ohio. When sufficiently cured, the hay is raked and immediately put in well-built cocks, the entire crew available being engaged in this operation until 10 or 15 acres have been cocked up. In case of rain the cocks are not opened until well dried off. When ready to stack, the cocks are upset so that they may dry out further. These upturned cocks are gathered in by buck rakes, from three to five at a time, and hauled to the stacker.

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[1] For more complete description of the different types of buck rakes in common use, see Farmers' Bulletin 838.

The stacker used is of the overshot type. (See fig. 12.) When in operation, it is loaded on the running gears of an ordinary wagon and hauled from place to place where the hay ricks are to be built. The stacker used by Mr. Rogers has been in operation for about five years and continues to give satisfaction. The outfit with two buck rakes cost, when new, $120.

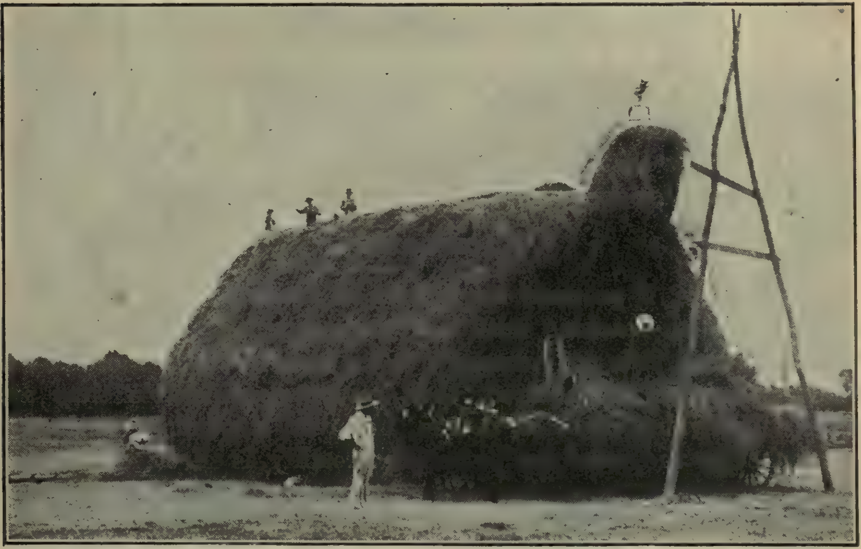

Fig. 13.—An inexpensive stacking device that may be used to advantage in putting up alfalfa hay where it is desirable to build large ricks.

Considering the small crew required and the amount of work that can be done in a given time, the adoption of some such outfit as this is well worth consideration where any considerable quantity of hay is to be stacked in the field.

The usual crew for operating such an outfit is two men to run the rakes, two men on the hay ricks, and one boy to drive the team on the stacker. Six horses in all are required—two on each of the buck rakes and two on the stacker. Five men and six horses with this outfit will gather in and stack from 2 to 3 tons of hay per hour, depending on the yield, the distance to be covered, and the skill attained in operating the equipment.

A homemade stacker.—A simple and inexpensive homemade stacking device which is coming into rather general use consists of four poles set up in pairs at each end of the rick, crossed and fastened together at the top, with a cable running through the forks made by the crossing of the poles. The cable, stretched tight and fastened to the ground at each end some distance out from the poles, serves as a track for the fork or sling.

Figure 13 shows a stacker of the above-described type in operation near Huntsville, Ohio. The 160 feet of ⅝-inch cable and the cable car cost $18 in May, 1917. The pulleys, forks, and 150 feet of rope were taken from the barn, thus eliminating special expense for these parts. The poles at each end of the rick are 31 feet high. The rick shown, which baled out 52 tons of hay, was put up by six men, one boy, and five horses in 2½ days of 10 hours each.

The first point to be observed in putting up such a stacker is to have the poles of sufficient strength to stand the strain, otherwise they will buckle and prevent satisfactory work. A fence stretcher is essential, to take up the slack in the cable, which may be necessary from time to time. This stacker is giving good satisfaction, taking into account its low cost, and it is very worthy of consideration as a stacking outfit for speeding up haying operations.

STACK COVERS.

Stack covers, if properly used, may be made a valuable asset in connection with stacking outfits of various kinds. When effective covers are used, it is not necessary to top out the rick so carefully as would otherwise be required, thus saving considerable time and labor. The value of stack covers, however, depends very largely upon whether the cover can be handled readily, is effective, and does not interfere with the curing of the hay. Numerous attempts have been made to use stack covers made of canvas, while others have been built of wood. Probably one of the most satisfactory stack covers is made of metal roofing material—usually corrugated roofing, though other metal covers of various designs are on the market.

Figure 14 shows a metal stack cover on a commercial alfalfa hay farm near Mechanicsburg, Ohio. This type of metal stack cover is reported to be very satisfactory. On most farms where this cover was found, the regular practice is to stack the hay in the field and leave it there until it is convenient to bale it in preparation for the market. The claim is made that the hay is thus about as well protected as if it were in the barn. The material for the stack cover shown in figure 14 was purchased in 1912. The price at that time was $64 for a cover 40 by 20 feet, but is much higher at present (1919). It is the usual practice on this farm to build ricks 16 feet wide, using three lengths of the covers instead of two as shown in figure 14

PASTURING ALFALFA.

The pasturing of alfalfa is not as yet a common practice throughout the Corn Belt. Owing to the comparative newness of the crop in the region, and the expense and difficulties which have been encountered in getting a stand in numerous localities, pasturing, as a rule, has been studiously avoided. Alfalfa as a pasture crop, however, is rapidly growing in favor among the more enterprising growers, especially where the crop can be grown without great difficulty.

In fact, throughout the region, as a whole, as the growers become familiar with the details of growing the crop, a tendency to use alfalfa as a pasture in a limited way becomes apparent. Especially after the stand has begun to fail, it is becoming common to pasture the crop for a year or two before plowing it up for corn.

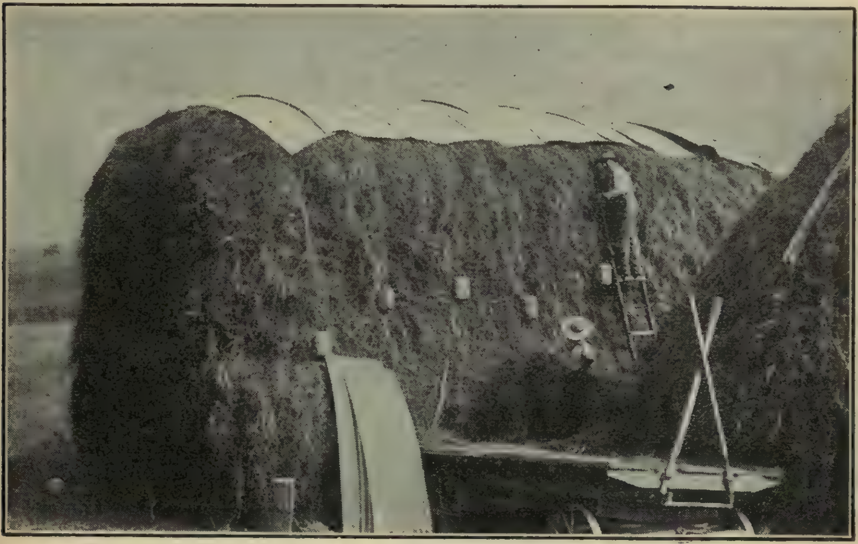

FIG. 14.—Metal stack covers save time and labor and prevent loss of hay from exposure to weather.

In central Iowa and throughout a great part of the typical Corn Belt area of Illinois, the scarcity of suitable hog pasture from the middle of July to the latter part of September has led most growers to pasture their alfalfa, at least after the second cutting of hay, regardless of whatever danger there may be of injuring the stand. Throughout the greater part of the Corn Belt in Indiana the growers are, as a rule, more conservative, but in west-central Ohio the pasturing of alfalfa is increasing rapidly. In the Corn Belt region, as a whole, about 22 per cent of the alfalfa farms visited used alfalfa as pasture very successfully, while on the other 78 per cent no attempt had been made to use the crop for this purpose.

Alfalfa has certain decided advantages over most of the other pasture crops of the region. It shoots up a vigorous growth early in the spring, and furnishes an abundance of forage until killed by frosts in the late fall. When a stand is once established a good pasture is generally assured for several years, thus eliminating considerable uncertainty.

Throughout July, August, and the greater part of September alfalfa meets a pressing need, when clover and bluegrass fall short and yield but little first-class forage.

Alfalfa has a greater carrying capacity than red clover at all times, and during the drier seasons of the year affords forage of much better quality.

METHODS COMMONLY FOLLOWED IN PASTURING ALFALFA.

The methods followed in pasturing alfalfa in the Corn Belt vary greatly according to adaptability of the crop to the locality, size of the farm, and acreage of alfalfa available for pasture. It is generally conceded that pasturing alfalfa shortens the life of the stand more or less, and in selecting a method of pasturing this fact is usually taken into consideration. It is usually considered injurious to turn in live stock very early in the spring, before the plants get a good start, or to pasture the crop closely during the latter part of the summer or late in the fall. In general, it is considered unwise to pasture alfalfa until after it is at least one year old.

As a rule, it is safe to assume that a good stand of alfalfa will last three or four years in the Corn Belt, even when used mainly for pasture, provided the method of pasturing is not extremely injurious. Several instances were found where alfalfa had been pastured judiciously for seven or eight years, and was still in fairly good condition. However, if the method of pasturing practiced is such that the crop is killed out one or two years sooner than it otherwise would be, it is generally considered to have served its purpose profitably.

CONTINUOUS PASTURING TO FULL CAPACITY OF THE CROP.

This is perhaps the least desirable method, certainly the one that kills out the stand most quickly. On old stands or in sections where conditions are very favorable for growing alfalfa, this method is doubtless permissible if a large amount of live stock is carried. As a method for the Corn Belt as a whole, however, this plan of pasturing is rather too destructive of the stand. If pastured continuously with reasonable care and at something less than the full carrying capacity, the stand may be maintained for several years in good condition, but close pasturing will soon reduce the carrying capacity materially.

Pasturing closely not only tends to kill out the stand, but encourages the growth of bluegrass. While the combination of bluegrass with alfalfa makes a good pasture, the alfalfa soon disappears altogether, after bluegrass once begins to come in. After pasturing alfalfa heavily by this method for a year or two, it is generally necessary to plow up the stand and put the field in some cultivated crop to kill out the bluegrass before seeding again to alfalfa.

INTERMITTENT PASTURING.

Intermittent pasturing is made possible by fencing the alfalfa pasture into three or more separate lots or fields. The live stock is pastured first on one, then on another. If there is not enough live stock to keep the crop pastured down, it may be clipped or some hay may be cut, after which the crop is allowed to grow up again before turning in live stock. Figure 15 shows a small acreage of alfalfa fenced off for use under this system of pasturing.

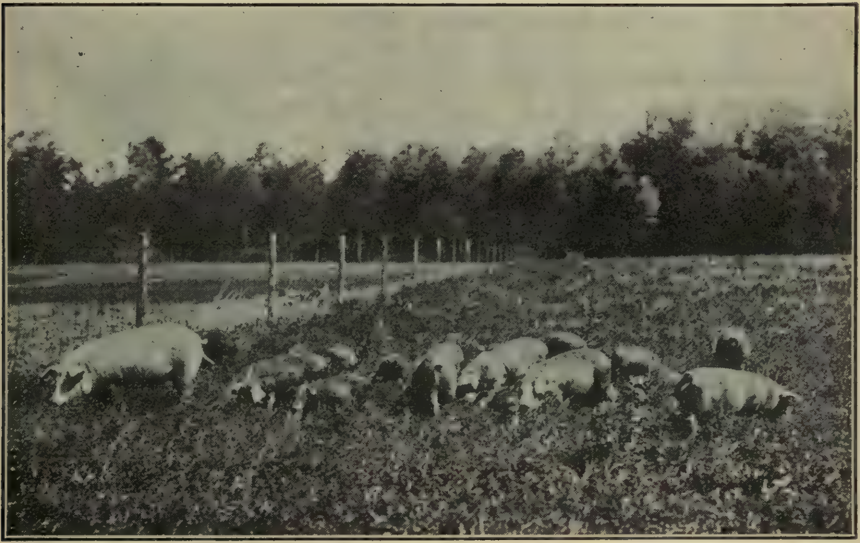

FIG. 15.—The hogs are pastured on one field for a while, then changed to another.

This system assures good quality of forage, but the method in general is not carried out successfully on many farms in the Corn Belt, as it requires too much labor for building fences and changing the live stock from field to field. If the alfalfa is pastured closely, this method is rather destructive to the stand, but if pastured moderately, usually little damage is done.

PASTURING CONTINUOUSLY AND CUTTING FOR HAY.

This method is more profitable and more suitable to Corn-Belt conditions than the methods above described. Under this plan the acreage of alfalfa is much greater than is needed for pasture, hence it may be cut at regular intervals. Figure 16 shows hogs pasturing a large field from which practically a full cutting of hay is being harvested.

If alfalfa is pastured lightly and a fairly good crop of hay is cut, the danger of injuring the stand is slight, and there is little, if any, need of discontinuing the pasturing while the crop comes on after cutting. In the case illustrated in figure 16, about one-third of the field was cut a week or 10 days earlier than the rest, thus insuring against a shortage of pasture for the hogs, which might have occurred had all the hay been cut at one time. This method requires no extra fencing and no changing of live stock to other fields, and is especially desirable where there is a fairly good acreage of alfalfa on the farm.[1]

FIG. 16.—If the acreage is more than is necessary to take care of the live stock, pasturing makes little impression on it.

PASTURING HORSES, CATTLE, AND SHEEP.

On several farms visited, horses are pastured on alfalfa with very satisfactory results. In numerous instances the farm work horses are pastured on alfalfa to a considerable extent when other pasturage is scarce. An instance of more extensive pasturing of the crop by horses was found on an Indiana farm on which the raising of purebred horses is an enterprise of considerable importance. Here, in addition to cutting some hay, it is the regular practice to pasture horses continuously on some of the older stands which contain more or less bluegrass. The horses do exceptionally well on this mixed pasture without grain, and the colts make very satisfactory growth.

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[1] Pasturing the hay crop is a system of pasturing alfalfa in use in the irrigated regions of Arizona, and might be applicable in the Corn Belt to some extent under certain conditions favorable for growing the crop. This system is described in Circular 54, Office of the Secretary, United States Department of Agriculture, and in brief consists of pasturing alfalfa, principally with cattle, to the extent of harvesting the entire hay crop in a short time. The fields are allowed to grow up almost to the time for cutting and then enough cattle are turned in to harvest the crop in 10 days or 2 weeks. Then they are turned into another field to repeat the process. Some of the fields are pastured sufficiently in the spring to delay the hay crop enough to cause different fields to be ready to cut for hay at different times, thus furnishing continuous pasturage.

This method was found in one instance in Indiana where cattle were turned in to harvest the last cutting of hay, and in a few instances enough sheep were turned in to accomplish practically the same results.

Numerous cases were found in which cattle and sheep also are pastured on alfalfa, but usually after the second or third cutting of hay. Cattle and sheep tend to bloat on alfalfa pasture, but the consensus of opinion is that, if the animals are properly handled, this danger is little if any greater than that from pasturing clover. It is considered usually of first importance that both cattle and sheep should be accustomed to alfalfa pasture gradually, by turning them on and off several times before giving access to the pasture continuously, and feeding well on hay each time before they are turned in.

By many it is considered safer, after the animals are once accustomed to the pasture, to leave both cattle and sheep on alfalfa continuously, regardless of rain or dew. If taken off for several hours and left without feed, then turned back on pasture, the animals while hungry are likely to eat large quantities of forage quickly, thus increasing the danger of bloat.

Some feeders consider it highly advisable to allow cattle to have access to cured hay most of the time while on alfalfa pasture, more especially during the early part of the pasture season. In general, the danger of bloating in pasturing alfalfa is much less during late summer than in early spring, and further the danger is still less when pasturing an old stand of alfalfa containing considerable bluegrass. On most farms cattle and sheep are not pastured on alfalfa until after the second cutting of hay, and in many instances not until after the third. Those who have followed these general precautions are finding but little difficulty in pasturing the crop.

EXPERIENCES OF SOME FARMERS.

Following are some of the specific experiences given by farmers who use alfalfa for pasture:

In 1916, pastured 5 acres of alfalfa with 40 ewes and their lambs from May 10 until September 1. It was an old stand. I gave a light feed of hay to prevent bloat and had no trouble whatever. The lambs made an average gain of 60 pounds each while on pasture.—Dan Lesh, Huntington County, Ind.

In 1916, pastured 8 acres of alfalfa with 135 ewes and 13 lambs during July. The ewes were thin but soon got in good condition. I had to accustom them to it gradually. The lambs made a good gain. From August 1 to September 6, I pastured 98 shoats and 130 lambs on this same field of alfalfa with access to corn with rape sown in it at the last cultivation. The results were very satisfactory.—William Jager, Mashka County, Iowa.

In the fall of 1917, I pastured 25 cattle on 15 acres of alfalfa then ready for the third cutting of hay. About two-thirds of the acreage was an old stand and contained considerable bluegrass. I was afraid of bloat, however, and took out insurance, but no losses occurred. The hay was harvested in a very satisfactory manner. The cattle were thin in the beginning, but took on flesh very rapidly.—W. V. Kell, Allen County, Ind.

Pastured 850 sheep on 25 acres of alfalfa from April 1 to May 15, 1916, to delay the first cutting of hay. The plan was a success. Cut the hay a month later than usual. Fed corn at the rate of three-fourths pound daily per animal, and each made a gain of 15 pounds. The sheep topped the Omaha market. The field was cut three times for hay after selling the sheep.—Jacob Weiss, Crawford, Iowa.

PASTURING HOGS.

Alfalfa is one of the most satisfactory and effective hog-pasture crops known to the Corn-Belt region, and is used more often in pasturing hogs than any other class of animals. Unlike sheep and cattle, hogs naturally have no tendency to bloat on alfalfa. Hogs can be turned in on alfalfa at any time and without any preliminary feeding or special management to get them accustomed to it. The only precautions necessary are those which safeguard the stand of alfalfa. The same care must be taken not to pasture too early or too late in the season, and grazing the stand too close to the ground has the same results regardless of the kind of live stock pastured.

Because of its palatability, hogs eat large quantities of alfalfa forage, and if fed at the same time a reasonable amount of corn they make very satisfactory gains. Fair gains, in fact, can be maintained under some conditions on alfalfa pasture alone, but this system of feeding is not advisable as a general practice. Some corn, if only a very light feeding, is essential to the making of economical gains, even on alfalfa pasture. The profits derived from pasturing alfalfa with hogs are usually very satisfactory and often more than can be derived in any other way.

FARM EXPERIENCES WITH ALFALFA HOG PASTURE.

Alfalfa is highly appreciated throughout the Corn Belt by all who have used it to any extent as hog pasture. By judicious use its value is being demonstrated throughout most parts of this region as a factor of great importance in commercial pork production. A few extracts from a number of reports are as follows:

Sowed 2½ acres of alfalfa for hog pasture. During the second year after seeding it pastured 80 shoats all season. During early spring, the growth was rank and the pigs small, and it became necessary to cut the alfalfa once for hay, securing about 1 ton per acre. Used this field in this way for 3 years without injury to the stand. Always cut once for hay, and after that the hogs keep it down fairly well. Always fed shoats some grain and got good gains.—W. A. Taylor, Story County, Iowa.

In 1916, put 14 sows and 114 pigs on 11 acres of alfalfa from April 1 until winter. Cut four times for hay and got 20 tons.—Edward Poiteven, Crawford County, Iowa.

For the past 4 years have used 8 acres of alfalfa for pasture and hay, from May 1 until late fall. Last year had 20 sows and 100 pigs on the 8 acres. Fed the pigs a light ration of corn. The spring pigs averaged 125 pounds by October 1, when turned in to hog down corn. Hogs could not eat all the forage in July and August. Cut the crop twice for hay, and got a total of about 2 tons per acre.—D. D. Hazelton, Carroll County, Iowa.

Last year had 35 sows and 165 pigs on 15 acres of alfalfa from May 1 until November 1. Cut the field 3 times and got 2 tons of hay per acre besides the pasture. Have been pasturing 8 acres in this way for 3 years. Bluegrass is coming in.—Charles G. Cockerill, Greene County, Iowa.

Pastured 12 sows and 120 spring pigs on 5 acres of alfalfa from May 1 until September 10, and cut 10 tons of hay besides. It was the best paying land on the farm.—W. O. Kunkel, Hancock County, Illinois.

Pastured 165 hogs on 25 acres of alfalfa from May 2 until September 15. Cut hay three times and got a total of 60 tons. The hogs do not reduce the yield of hay materially.—Huddleston Farm, Dewitt County, Ill.

We usually set aside 7 acres of alfalfa for hog pasture and use it from May 10 to September 1. Generally it is necessary to cut twice. Get about a ton of hay per acre, all told. The plan is to pasture only to half of its carrying capacity, and to leave some to be cut for hay. Have used the 7 acres in this way for three years without injury. We average about 40 sows and 300 to 350 spring pigs on this pasture. When the number is too great for the pasture, the hogs are turned on another alfalfa field for a short period.—J. M. Ballard, Grant County, Ind.

A number of farmers report pasturing alfalfa after the third cutting of hay. Usually forage is abundant on the average farm up to August 1, but then alfalfa meets a pressing need. The value of alfalfa as a pasture crop during the latter part of the season, when other pasturage is very scarce, can not easily be overestimated. Two of the Iowa reports in this regard are as follows:

Pastured 180 hogs on 10 acres of alfalfa all season. Turned off about 10 days after each cutting. Sometimes turned 8 or 10 milch cows on the field in the fall and let the stock harvest all the last cutting. No trouble from bloating. Am well pleased with the results.—Walter Tomlinson.

For the past four years have pastured 4½ acres of alfalfa with about 50 shoats after the third cutting of hay, usually while hogging corn.—Estes Gates, Newton, Iowa.

RESULTS WITH A POOR STAND OF ALFALFA.

It is often a question what to do with a poor stand of alfalfa, and it is difficult to decide whether to plow it up and reseed or to use it further for pasture. In several instances the bare spots were disked and harrowed and rape seed with some oats was sown broadcast. The following report gives some idea as to the value of an old stand when used as a pasture in this way:

In 1917 sowed 4 acres of old alfalfa stand with a mixture of oats and rape early in the spring. April 28 turned on 28 shoats with the following results:

April 28, 28 shoats averaged 71 pounds each, total 1,988 pounds. June 28, 28 shoats averaged 133.2 pounds each, total 3,730 pounds. Gain in 62 days 62.2 pounds each, total 1,741 pounds.

Altogether the hogs received 24 bushels of corn and 28 bushels of oats. Daily gain was 1 pound. Gilts were thin and in good condition to take on weight. About 1½ pounds of grain feed was consumed per pound of gain.

A good example of continuous pasturing of hogs on alfalfa with grain fed in self-feeders is afforded by feeding demonstrations conducted during the season of 1917 on the Borgelt farm at Havana, Ill.

The hogs were fed principally on corn in connection with the alfalfa pasture with the following results:

July 1, 133 shoats, average weight 70 pounds, total 9,310 pounds. October 1, average weight 210 pounds, total 27,930 pounds; 91 days, average gain 140 pounds, total gain 18,620 pounds.

Average daily gain, 1.5 pounds.

Feeds consumed: Corn, 1,220 bushels; middlings, 1,500 pounds.

Grain per 100 pounds of gain, 375 pounds.

Gain per bushel of corn fed, 15.3 pounds.

The small amount of middlings was used in the beginning of the demonstration, after which the only feed available was the corn in self-feeders and the alfalfa pasture. In addition to the pasture afforded, the 15 acres of alfalfa produced 28 tons of hay. Reducing the results to an acre basis, the feeding of 81.3 bushels of corn and 100 pounds of middlings on an acre of alfalfa made possible a total return of 1,241 pounds of pork and 1.9 tons of hay. The results in this instance are very satisfactory and further illustrate the method of continuous heavy pasturing after the first cutting of hay.

ADVANTAGES AND LIMITATIONS OF ALFALFA GROWING.

There are a number of difficulties in growing alfalfa over a large part of the Corn Belt mainly because of soil and climatic conditions; but there is ample evidence that if grown successfully without too great initial expense the crop becomes a valuable asset on most farms of the region.

The present indications are that alfalfa will not replace the common clovers to any great extent on Corn-Belt farms. Everything considered, it is of greater value when grown on a comparatively limited acreage to supplement the hay and pasture crops of the regular rotations.

On live-stock farms alfalfa is especially valuable in that the increase in hay and pasture makes it possible to add greatly to the number of live stock kept, or, in some instances, additional hay may be sold on the market. On grain farms an acreage of alfalfa makes it possible to plow under a large part or all of the clover in the rotation for soil improvement.

As more rapid and labor-saving methods are adopted in putting up alfalfa hay and in the cultivation of corn, the acreage of alfalfa on Corn-Belt farms may be increased without seriously deranging the labor program. In the Corn Belt proper it is doubtless more important than in any other section of the country to give careful consideration to methods of relieving labor pressure if alfalfa is to be introduced into the cropping system in any considerable acreage.

Experience is proving that alfalfa is the most valuable pasture crop so far grown in the region, especially for hogs. It furnishes an all-summer pasture of the best quality, and indications are that the crop will continue to be used to a much greater extent for pasture purposes.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1919

LAWS RELATING TO FUR-BEARING ANIMALS, 1918

A SUMMARY OF LAWS IN THE UNITED STATES, CANADA, AND NEWFOUNDLAND, RELATING TO TRAPPING, OPEN SEASONS, PROPAGATION, AND BOUNTIES

DAVID E. LANTZ
Assistant Biologist

FARMERS' BULLETIN 1022

UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from the Bureau of Biological Survey
E. W. NELSON, Chief

Washington, D. C. December, 1918

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WASHINGTON : GOVERNMENT PRINTING OFFICE : 1918

FOR THE FISCAL YEAR ended June 30, 1918, the foreign trade of the United States in raw and manufactured furs reached the largest total in the history of the country. While exports were only $13,903,631 as compared with $15,729,160 for 1917, the imports were $38,389,372 as compared with $21,553,375 for 1917. The total foreign trade in furs increased over 40 per cent.

Last season was unfavorable for trapping; as a result furs were scarce and prices high. The present regulations of the War Trade Board requiring licenses and imposing other restrictions on raw fur importations will make manufacturers more than ever dependent on the home supply. Trappers may, therefore, expect still higher prices for the catch of the coming season.

Under the stimulus of high prices there is always danger that trappers will deplete the trapping grounds and permanently decrease the number of fur animals. All should be on their guard to see that regulations and seasons are carefully observed, so that the fur supply of the future shall not be endangered.

LAWS RELATING TO FUR-BEARING ANIMALS, 1918.[1]

A SUMMARY OF LAWS IN THE UNITED STATES, CANADA, AND NEWFOUNDLAND RELATING TO TRAPPING, OPEN SEASONS, PROPAGATION, AND BOUNTIES.

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LEGISLATION OF 1918.

Only 11 of the States held regular sessions of the legislature in 1918, and few changes in laws relating to trapping, propagation of fur animals, and bounties were enacted. The few special sessions of legislatures were called for specific purposes, which did not involve trapping or game legislation. While the Canadian legislatures held regular sessions, they were concerned largely with legislation on war or industrial subjects, and made few changes in trapping laws. Some of the sessions, however, are held in midsummer, and reports of new legislation may be still lacking. In some Provinces changes in trapping or bounty regulations have been made by "orders in council." All changes reported up to August 15, 1918, are included in the present compilation.

Alaska.—Regulations of the United States Department of Commerce have extended the close term on beavers, which ended November 1, 1918, an additional five years, to November 1, 1923.

Louisiana.—The legislature passed two general acts amending the game-conservation law of the State. The open season for bears was lengthened by 15 days. The taking or killing of beavers has been prohibited (acts 88 and 106).

Maryland.—Several local laws affecting the taking of fur animals were enacted. House bill 301 relates to hunting foxes in Baltimore County; house bill 289 changes the open season for raccoons in Dorchester County; house bill 522 relates to taking muskrats in Kent County; and house bill 301 to taking them in Wicomico. A bounty on chicken hawks is to be paid hereafter from the State game-protection funds (house bill 24).

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[1] Prof. David E. Lantz, author of this bulletin, died on October 7, 1918, after a very brief illness, soon after the completion of the manuscript.—Editor.

Massachusetts.—Trappers may hereafter lawfully "take captured animals from traps on the Lord's Day."

New Jersey.—The fox bounty law was amended (ch. 179).

New York.—The conservation commission has been authorized to issue licenses to capture wild animals for propagation, on payment of a nominal fee of $1 (ch. 282).

South Carolina.—Act No. 404 of the recent session fixes a closed season for foxes, raccoons, opossums, minks, otters, and skunks in Horry County.

Virginia.—A closed season on muskrats has been fixed for King George County. Local bounty laws were enacted for hawks in Fauquier County and for crows in Rockingham. A general bounty law for the goshawk and the Cooper hawk was enacted, not obligatory.

New Brunswick.—The bounty on wildcats has been increased to $2 and bounties have been placed on porcupines, hawks, and owls.

Northwest Territories.—General trapping regulations with changes in open seasons were enacted in September, 1917.

Ontario.—A closed season has been established on fisher and marten. The license fees of fur dealers have been increased and the bounty on gray timber wolves raised from $15 to $20.

Quebec.—Trapping regulations and open seasons have been changed and are now uniform for the entire Province.

Yukon.—Beavers are now protected at all seasons.

FEDERAL LAWS.

Two Federal laws have a bearing on the fur industry of the United States—the Lacey Act, governing interstate commerce in game, and the tariff act of October 3, 1913.

That part of the Lacey Act codified as section 242 of the Criminal Code (35 Stat., 1137) makes it unlawful to ship or transport "from any State, Territory, or District of the United States, to any other State, Territory, or District thereof" the bodies or parts of bodies of any wild animal or bird killed or shipped in violation of law of the State, Territory, or District in which the same were killed or from which they were shipped. This makes it unlawful to ship out of any State skins or pelts illegally taken. Packages containing furs, when shipped in interstate commerce, must be plainly marked, so that the name and address of the shipper and the nature of the contents may be readily ascertained by inspection of the outside of the package.

The tariff act of 1913 places a duty of 10 per cent ad valorem on live animals shipped into the United States. Paragraph 397 of this law places on the free list animals imported for breeding purposes by a citizen of the United States: "*Provided*, That no such animal shall be admitted free unless pure-bred of a recognized breed and duly registered in a book of record recognized by the Secretary of Agriculture for that breed." This act has made it impossible thus far to admit free of duty any foxes or other Canadian fur animals for propagation. Raw furs not advanced in manufacture are admitted free of duty, but licenses for importation are now required under the regulations of the Federal Trade Board.

LAWS OF STATES AND PROVINCES.

The following is a summary by States and Provinces of trapping regulations now in force, open seasons for taking fur animals, provisions relating to their propagation and possession, and to bounties offered for the destruction of predatory species, or those considered harmful. The whole is followed by a brief summary of the protection now given to the more important species.

The laws relating to deer and other big game, rabbits, and squirrels are not considered here, as they appear in the annual game-law bulletin.[1] Those relating to bears are included, mainly because of their connection with bounties.

The bounty laws relate to all animals on which bounty is paid.

Throughout the following pages references to legislation give date of law or code, followed by the number of the section, chapter, or act containing the provision. References are sometimes omitted when provisions from various enactments are grouped in a single sentence or short paragraph.

Under the heading "Trapping" the expression "no legal restrictions" indicates that no specific trapping provisions exist, the general trespass laws of the State not having been considered.

Under the heading "Open seasons" the dates given are, unless otherwise stated, *the first and last days of the open season.*

ALABAMA.

Trapping.—Poisons, drugs, or chemicals may not be used in taking game or fur animals.

Open seasons.—No close season for fur animals.

Propagation.—No legal restrictions.

Bounties.—None paid.

ALASKA.

Trapping.—The Secretary of Commerce makes all regulations for taking fur animals in Alaska. Under regulations published March 16, 1918, it is unlawful to use a "klips" trap, a steel bear trap, or any trap having a spread exceeding 8 inches; to kill any fur-bearing animals with strychnin or other poison; to trap protected fur animals at any time when the skin or pelt is not prime; or to have in possession or sell or export unprime skins of animals protected by close seasons (such skins subject to confiscation). Shipments of furs must be reported to the Bureau of Fisheries, Department of Commerce, on blanks provided for that purpose.

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[1] Farmers' Bulletin 1010, Game Laws for 1918.

Open seasons.—Land otter and mink, November 16 to March 31; fox and weasel, November 16 to March 14; muskrat, December 1 to May 31; lynx (wildcat), November 16 to February 28 (29). No close season for black bear, wolf, wolverine, ground squirrel, or rabbit.[1] Close season on marten until November 15, 1921; on sea otter until November 1, 1920; on beaver until November 1, 1923. No open season in Aleutian Islands Reservation, and trapping may be done there only by special permit.[2]

Propagation.—Owners of establishments for breeding fur animals are subject to the same restrictions as to season for killing and condition of pelts as are trappers of wild fur-bearing animals. Fur farmers are required to furnish reports to the Bureau of Fisheries and to allow agents of that bureau free access to establishments where animals are kept in captivity.

Within the Aleutian Islands Reservation the Department of Agriculture grants permits to propagate fur animals and to trap them for breeding purposes.

An act of the territorial legislature protects premises of fox breeders or breeders of other fur animals from trespass (1917, ch. 43).

Bounties.—Wolf, $15; eagles, 50 cents (1917, chs. 63, 12).

ARIZONA.

Trapping.—No legal restrictions except on State game preserves, where mountain lion, fox, coyote, lynx, wildcat, and skunk may be taken under regulations of the State game warden.

Open seasons.—No close season for fur animals.

Propagation.—No legal restrictions.

Bounties.—County boards shall pay, for wolf or mountain lion, $10 each; they may pay, for coyote, $2; lynx or wildcat, $1; raccoon, 25 cents; jack rabbit, gopher, or prairie-dog, 5 cents (1912, ch. 82).

ARKANSAS.

Trapping.—A person using 10 or more traps to take fur animals is required to secure an annual trapper's license (fee, $10). Unlawful to trap bears, to hunt them at night with torch or searchlight, or to sell or exchange the animals (1917, No. 133).

Open seasons.—All fur animals, except beaver, otter, and bear, October 1 to February 28 (29); bear, November 11 to January 10; beaver and otter, no open season before January 1, 1922. Raw skins of fur animals may not be possessed or sold, except between October 1 and March 15. Fur animals found destroying crops or poultry may be killed at any time (1917, No. 133).

Propagation.—The game and fish commission is authorized to issue permits to breeders of game and fur animals under such regulations as it may prescribe (1917, No. 133).

Bounties.—County courts may offer bounty on wolf, wildcat, or panther, and fix the amount of such bounty (1895, No. 44).

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[1] *South of latitude 62°.*—Open season for brown bear, October 1 to July 2. *North of latitude 62°.*—Open season for walrus, May 10 to July 2; no close season for brown bear or sea lion. (35 Stat., 102.)

[2] The fur-seal fisheries, the Aleutian Islands Reservation, and the Afognak Reservation are subject to special legislative and administrative control. For specific information regarding them, application should be made to the Commissioner of Fisheries, Washington, D. C.

CALIFORNIA.

Trapping.—License required of trapper over 18 years old (fee $1; alien, $2). Licensed trapper is required to report catch before July 1. Fur animals may be killed at any time when destroying property. Unlawful to use poisons in taking fur animals or to dig or smoke out skunks from dens (1917, ch. 517).

Open seasons.—No open season for beaver or sea otter. Open season for black or brown bear, ring-tail cat, coon, pine marten, fisher, wolverine, mink, skunk, river otter, and fox, November 1 to end of February (1917, ch. 517). Seals and sea lions are protected at all times in game district 19 (Penal Code, sec. 637).

Propagation.—No legal restrictions.

Bounties.—Mountain lion, female $30; male, $20; paid by State game commission. Boards of supervisors of counties may at their discretion fix the rate and pay bounty on coyote, wild cat, fox, lynx, bear, or mountain lion. Many counties now pay a bounty on some of these animals, especially on coyotes.[1]

COLORADO.

Trapping.—Hunting license required for trapping; fee, resident, $2; nonresident, $25. Beavers may not be trapped for fur at any time, but the owner of property damaged by the animals may apply to the State game and fish commissioner for a permit to kill them under such regulations as he may provide as to the disposition of the skins (1909, revising secs. 2753, 2759b).

Open seasons.—No close season for fur animals, except beaver.

Propagation.—No legal restrictions, except as to beaver and game animals.

Bounties.—None paid by State since 1895. On petition of 50 freeholders, county commissioners may levy a tax to pay a bounty on coyote, wolf, and mountain lion.

CONNECTICUT.

Trapping.—Unlawful to trap with scented baits (1903, ch. 56); to trap on lands of another without owner's permission (1909, ch. 37); and to take animals with a snare (1913, ch. 79). Traps must be visited at least once in 48 hours and must not be set in path, wood road, or specially prepared furrow (1917, ch. 403). Hunting license is required for trapping (except on land owned by trapper); fee, resident, $1; nonresident, $10; alien, $15; with an additional 25 cents recording fee for each license. Persons under 16 years of age, while denied a hunting license, may obtain one for taking fur animals only (1917, ch. 153; 1915, ch. 240).

Open seasons.—Otter, November 1 to March 31 (1905, ch. 5); raccoon, October 16 to February 28 (29), but landowner may kill the animals at any time to protect crops (1917, ch. 207); skunk, November 1 to April 30; may be taken at any time to protect property (1917, ch. 43). No close season on other fur animals.

Propagation.—No restrictions on possession or sale of fur animals kept in captivity.

Bounties.—Towns are permitted to pay bounty on wild cat or fox (not over $5) on weasel, woodchuck, wild Belgian hare, or wild German rabbit (not over $1) (1917, ch. 83).

DELAWARE.

Trapping.—Nonresident trappers are required to hold hunting license (fee $10.50). Unlawful to use pitfall, deadfall, scaffold, cage, snare, trap, net, pen, baited hook, or baited field or any other similar device, or any drug, poison, chemicals, or explosives for taking birds or animals protected by the laws of this State, except muskrats, skunks, minks. and otters, and except as otherwise expressly provided. Traps or other devices unlawfully set are subject to confiscation (Rev. Stat. 1914, sec. 2378). Muskrats may not be taken during the time of any flood or freshet when such flood or freshet may cause them to leave their usual places of shelter and protection (sec. 2387). Muskrats may not be shot at night (sec. 2380) or hunted with a dog (sec. 2388). Unlawful to destroy the nest, den, or lair of any animal protected by law (sec. 2378). Unlawful to hunt, kill, take, or destroy any protected animal, except muskrat, skunk, mink, and otter, while the ground is covered with snow (sec. 2382). Unlawful to shoot at or destroy any fox while such fox is being chased by dog or dogs (sec. 2385). Unlawful to sell or export any fox or fox hides (sec. 2408). Owners of property may at any time destroy fur-bearing animals to protect such property (sec. 2375).

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[1] For information in regard to bounties in any county, application should be made to the county clerk.

Open seasons.—Skunk and mink, December 1 to March 25; fox, October 1 to April 30; raccoon and opossum, October 1 to February 15; otter, no open season. Muskrat in Kent and Sussex Counties, November 20 to March 25; in Newcastle County, inland and embanked meadows, December 1 to March 25; all other marshes, December 1 to March 10. Muskrat meat may be sold anywhere in the State, November 20 to April 1 (1917, ch. 210, 211).

Propagation.—No restrictions, provided a permit is obtained from the chief game and fish warden (fee, $1). A restricted number of wild fur or game animals for propagating purposes may be taken under permit.

Bounties.—None paid.

DISTRICT OF COLUMBIA.

No legislation relating to fur animals.

FLORIDA.

Trapping.—No legal restrictions.

Open seasons.—Beaver and otter, November 1 to January 31 (1905, No. 57). No close season for other fur animals.

Propagation.—No legal restrictions.

Bounties.—None paid.

GEORGIA.

Trapping.—Permission of owner required to trap on lands of another. Hunting license required to trap outside one's own militia district; fees for State license, nonresident, $15; resident, $3; county license, $1.

Open seasons.—Opossum, October 1 to February 28 (29) (C. Code 1911, sec. 590); fox, Habersham County, September 1 to May 14 (1914, No. 304). Fur animals not otherwise protected.

Propagation.—No restrictions on propagation of unprotected fur animals.

Bounties.—None paid.

HAWAII.

Hawaii has no wild animals valuable for fur. There are no restrictions on the propagation of fur animals, except that mongooses and rabbits may not be kept or bred. Pet rabbits may be raised, if kept in confinement (1905. ch. 37).

IDAHO.

Trapping.—No restrictions, except in State game preserves.

Open seasons.—No open seasons for otters or beavers, but owner of property destroyed by beavers may obtain a permit to kill them from the State fish and game warden. Skins of animals so killed must be sent to the warden, who shall sell them and apply the proceeds to the State game fund (1911, ch. 62). No close season on other fur animals, except in State game preserves.

In Black Lake Game Preserve, beaver, otter, marten, fisher, fox, mink, and wolverine are protected at all times; mountain lion, bear, lynx, wolf, coyote, and wildcat may be destroyed by game warden or duly authorized person (1915, ch. 9).

In Payette Game Preserve, bear, lynx, wolverine, fox, otter, beaver, marten, mink, and fisher are protected at all times; mountain lion, timber wolf, coyote, and wildcat may be killed by game wardens or duly authorized persons (1909, H. B. 242).

In Big Creek, Selway, and Big Lost River Game Preserves, beaver, otter, marten, fisher, fox, and mink are protected at all times; mountain lion, bear, lynx, wolf, coyote, wolverine, and wildcat may be killed by game wardens or duly authorized persons (1917, chs. 29, 38, 54). In Big Lost River Preserve, badgers, weasels, skunks, and rabbits may be killed by anyone without permit (1917, ch. 29).

Propagation.—No restrictions, except in game preserves.

Bounties.—Coyote, lynx, or wildcat, $2.50 each; bear or wolf, $10; mountain lion, $25; paid from predatory wild animal fund administered through the State live stock sanitary board (1915, ch. 73). Bounty of 2 cents each on pocket gopher, ground squirrel, and prairie dog; fund raised by taxation; administered like predatory wild animal fund (1917, ch. 102).

ILLINOIS.

Trapping.—No legal restrictions.

Open seasons.—Raccoon, mink, muskrat, skunk, opossum, and otter, November 1 to March 31 (1915, S. B. 439, sec. 4).

Propagation.—Permit is required to conduct a fur farm on which protected animals are reared; fee, $2, and bond of $500 required (1915, S. B. 409).

Bounties.—None paid by State. Counties may at their discretion pay bounty on ground hog and crow (1909, H. B.'s 686, 687).

INDIANA.

Trapping.—Nonresident trapper requires license (fee, $15.50). Trapping on lands of another without written consent of owner, occupant, or lessee is unlawful. Traps set on such lands must be placed within burrow of animal or a hollow log and must be visited at least once in each 36 hours (1917, ch. 137). Protected fur animals may be killed at any time on one's own premises to protect property (1911, ch. 6).

Open seasons.—Beaver, raccoon, fox, otter, opossum, and skunk, November 20 to February 1; mink and muskrat, November 1 to March 31 (1917, ch. 137). Muskrat houses protected at all times, except when obstructing ditches or watercourses.

Propagation.—All birds and animals raised in captivity are considered domestic stock, and the owner may possess, sell, ship, transport, or otherwise dispose of them without regard to laws regulating the killing and disposition of wild birds and animals (1915, H. B. 37).

Bounties.—Crow, 10 cents each; may be paid by counties (1911, ch. 133). Boards of county commissioners are authorized at their discretion to pay bounty on wolf, fox, woodchuck, owl, or hawk (Ind. Stat., Burns, sec. 7871).

IOWA.

Trapping.—Hunting license required for trapping; fee, resident, $1; nonresident, $10.50 (1915, S. F. 621).

Open seasons.—Beaver, mink, otter, and muskrat, November 15 to March 15; may be destroyed at any time to protect public or private property. Muskrat houses are protected at all times. Possession of beaver, mink, otter, or muskrat is lawful only during open season and first five days of close season (1917, ch. 396).

Propagation.—No restrictions except as to possession of protected species.

Bounties.—Adult wolf, $20; wolf cub, $4; wildcat, $1; paid by county (1913, ch. 189). Boards of supervisors of counties may allow bounty on crow, ground hog, pocket gopher, or rattlesnake.

KANSAS.

Trapping.—The owner or legal occupant of land may destroy fur-bearing animals protected by law when such animals are destroying poultry or damaging other property (1911, ch. 198).

Open seasons.—Muskrat, skunk, mink, raccoon, opossum, and civet cat, November 15 to March 15. No open season for beaver or otter until 1921 (1911, ch. 198).

Propagation.—Permits for raising fur animals protected by law are issued by State game warden.

Bounties.—Coyote, $1; wolf, $5; crow and pocket gopher, 5 cents each; paid by county.

KENTUCKY.

Trapping.—Written consent of owner or lessee required to trap on lands of another. Traps must be set 18 inches or more within a hole, cave, or hollow log, and must be visited within each 36 hours. Traps set unlawfully may be seized or destroyed by anyone. Fur animals may be killed at any time on one's own premises to protect property (1916, ch. 87).

Open seasons.—Beaver, mink, raccoon, otter, opossum, and skunk, November 15 to December 31; but raccoon, opossum, skunk, and mink may also be taken and killed by dog or gun, October 1 to February 15.

Propagation.—No legal restrictions.

LOUISIANA.

Trapping.—License for trapping is required; fee, resident, $2; nonresident, $15 (1914, ch. 293). Muskrats may be taken at any time within 5 miles of any levee, and may be killed by the owner of land upon which they are destroying property. Skins of animals killed in open season may be possessed in close season. Wild ducks may not be used for trap bait (1912, ch. 204).

Open seasons.—Bear, November 1 to February 15 (may not be trapped); muskrat, mink, otter, raccoon, skunk, fox, and opossum, November 1 to February 15; beaver, no open season (1918, act 106).

Propagation.—Fur animals for breeding purposes may not be captured during the close season. Permit from the department of conservation is required to import wild quadrupeds into the State or to export them from the State (1918, act 88).

Bounties.—None paid.

MAINE.

Trapping.—Trappers in unorganized townships of the State are required to take out an annual license (fee, $5), and on or before December 15 of each year must make such report as the commissioner of inland fisheries and game may require (1911, ch. 64). Any person who sets a trap in an organized county or incorporated place must obtain written consent of the owner or occupant of land on which the trap is set, and must visit such trap at least once in every 24 hours and remove animals caught (1915, ch. 277). All traps must be plainly marked with owner's name and address, either by having the same stamped on the trap or on a metal tag firmly attached to it (1915, ch. 277.) A bear trap must be inclosed in a "hut" and must have a notice that it is set posted conspicuously near it (1915, ch. 277).

Dealers in skins of fur animals must each year take out a license (fee, $2) to engage in this trade and must keep a record of transactions and forward same to the commissioner of inland fisheries and game on or before December 20 (1915, ch. 277). Putting out poison for wolves, foxes, dogs, or other animals is forbidden under penalty of fine or imprisonment (1909, ch. 134).

Traps may not be set within 25 feet of a muskrat house. A special law protects muskrats on Lower Kezar Pond and certain adjacent territory for four years from July 3, 1915 (1915, ch. 19). On complaint by landowners of damage done by beavers, the commissioner of inland fisheries and game has authority to declare an open season for beavers on lands where damage occurs (1915, ch. 222). Any person may lawfully kill any wild animal, except beaver, found destroying his property (1915, ch. 334). Unlawful to dig out a fox den at any time (1917, ch. 219).

Open seasons.—All fur animals (except beaver, muskrat, raccoon, bear, bobcat, Canada lynx (loup cervier), and weasel), October 15 to February 28 (29); muskrat, October 15 to April 30[1]; raccoon, August 15 to February 28 (29). No open season on beaver except when declared by the commissioner of inland fisheries and game. No close season on bear, bobcat, Canada lynx (loup cervier), or weasel (1913, ch. 206).

Propagation.—Permit required to raise fur animals. Protected species may not be captured in close season for stocking fur ranches, and no animals may be imported into the State without permit.

Bounties.—Bobcat and Canada lynx (loup cervier), $4 each; paid by State. Claim for bounty must be made within five days after killing or return from trip on which killing was done (1913, ch. 206). Bounty on bears, $5 each; paid by State, claim to be made within 10 days after killing (1917, ch. 215).

MARYLAND.

While the State has recently adopted a uniform open season for game, the counties still regulate the taking of fur animals. The State law protecting otter, raccoon, and muskrat between April 1 and January 1 (1900, ch. 371) was amended until it applied to only six counties (1912, ch. 843), and some of these have local laws which take precedence. Local laws providing protection to fur animals or regulating their capture are in force in the following counties:

Allegany County.—Raccoon and opossum, open season, September 1 to March 31; hunting license required to capture either (1916, ch. 282). Bounty on wildcat, $2; fox, $1; hawk or hoot owl, 50 cents (1910, ch. 616).

Anne Arundel County.—Raccoon, open season, October 1 to January 31; may not be taken between sunrise and sunset; unlawful to cut down tree to obtain a raccoon (1916, ch. 367); muskrat, open season, December 2 to February 28 (29). Unlawful at any time to destroy muskrat dens or houses, unless the animals are destroying property (1906, ch. 589).

Baltimore County.—Unlawful to set traps, except from November 10 to December 20. Unlawful to pursue or kill raccoons and opossums, except from October 1 to February 28 (inclusive); unlawful to hunt them on Sundays or when snow covers the ground. Permits to take certain predatory fur animals when destroying property may be obtained, but such permits may be revoked at any time by the chief game warden (1912, ch. 751). Foxes may not be shot or shot at while pursued by dogs, and it is a misdemeanor to dig young foxes or vixen from dens (1918, ch. 317).

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[1] Exception: A special law protects muskrats on Lower Kezar Pond and certain adjacent territory until July 3, 1919.

Caroline County.—Muskrat, open season, December 15 to March 31; raccoon, September 15 to March 31; otter, December 15 to March 31 (1902, ch. 157). Unlawful for nonresidents to trap without license (fee, $4.50). Unlawful to dig into or destroy muskrat homes or dens, except when animals are destroying property (1902, ch. 157). Unlawful to use reflector or artificial light in taking muskrats or otters (1904, ch. 91). Unlawful to kill a fox except by hounds in a hunt or when the fox is destroying poultry (1916, ch. 450).

Carroll County.—Unlawful to kill fox except by hounds in a hunt or when the fox is destroying poultry (1916, ch. 450).

Cecil County.—Muskrat, open season, December 1 to February 28 (29); may be taken only by trapping (1914, ch. 39).

Charles County.—Unlawful to shoot muskrats on Nanjemoy Creek and tributaries by aid of light (1912, ch. 362).

Dorchester County.—Open season, raccoon, November 10 to March 14 (1918, ch. 123); otter, January 1 to March 31 (State law); muskrat, January 1 to March 15 (local law). Unlawful to shoot muskrats (1900, ch. 205) or to use artificial light in taking them. Bounty on crow, 5 cents.

Frederick County.—All fur animals, open season, November 15 to February 28 (29), but night hunting with dogs for raccoon or opossum is lawful at any time (1916, ch. 128). Bounty on wildcat, $2; mink or fox, $1; weasel, owl, or hawk, 50 cents.

Garrett County.—Bounty on panther or wolf, $20; wildcat, $3; fox, $1; weasel, 50 cents (1916, ch. 13).

Harford County.—Except for muskrats, trapping is forbidden between December 25 and November 15 of the following year. Open season for raccoon, October 2 to November 30. License required to take muskrats or skunks; fee, resident, $1.15; nonresident, $5.15. Unlawful to trap on private property without permission of owner. Bounty of 50 cents each on chicken hawk, pigeon hawk, booby owl, or weasel (1916, ch. 307).

Kent County.—Otter, raccoon, and muskrat, open season, January 1 to March 31 (State law). Unlawful to shoot muskrat or otter by light at night (1918, ch. 337).

Montgomery County.—Raccoon and opossum, open season, October 15 to January 14; muskrat, November 15 to February 28 (29). Nonresident requires license to hunt raccoon or opossum (fee, $15.50). Setting a snare or trap in or about a fox den is unlawful. Bounty on hawks, 40 cents (1912, ch. 438).

Prince Georges County.—Unlawful to hunt, shoot, or trap muskrats in Aquasco district between March 15 and January 1, or to spear them at any time (1910, ch. 688). Raccoon, open season, October 1 to January 31; may not be taken between sunrise and sunset; unlawful to cut down tree to capture raccoon (1916, ch. 376).

Queen Annes County.—Otter, raccoon, and muskrat, open season, January 1 to March 31 (State law).

Somerset County.—Otter and raccoon, open season, January 1 to March 31 (State law); muskrat, January 1 to March 15 (local law). Unlawful at any time to shoot muskrats (1918, ch. 251).

Talbot County.—Otter and muskrat, open season, December 16 to March 15. Dealers may have skins of either in possession up to March 31. Unlawful to take otter or muskrat at night, except in traps (1912, ch. 785).

Washington County.—Muskrat, mink, skunk, opossum, and otter, open season, December 1 to March 31 (1916, ch. 320). Unlawful to shoot foxes while they are being chased by dogs.

Wicomico County.—Otter, mink, and muskrat, open season, December 15 to February 28 (29). Muskrats may be taken only by traps and muskrat houses are protected at all times (1918, ch. 379).

Worcester County.—Muskrat, otter, and mink, open season, December 15 to February 28 (29). Unlawful to trap on lands or marshes of another without permission (1910, ch. 239). Unlawful to chase fox with dogs, March 10 to August 31, or to shoot any fox while it is pursued by dogs (1904, ch. 652).

Bounties.—A State bounty of 50 cents each on bird hawk or chicken hawk killed in the State, paid from the State game protective fund (1918, H. B. 24).

MASSACHUSETTS.

Trapping.—Poison may not be used to kill animals, except rats, woodchucks, or other pests on one's own premises. The use of steel traps with spread of over 6 inches and "choke" traps with greater opening than 6 inches is unlawful, as is also the use of wire snares or of scented baits. Traps may not be set on lands of another without written consent. Traps must be visited at least once in 24 hours. Animals "may be taken from traps on the Lord's day" (1918, ch. 53). Introduction of foxes or raccoons in Dukes County is prohibited (Rev. Laws 1902–1908, ch. 92).

Open seasons.—No close season for fur animals.

Propagation.—No legal restrictions.

Bounties.—Wildcat or lynx, $5; paid by town, but refunded by county (1903, ch. 344).

MICHIGAN.

Trapping.—License required for trapping; fee, resident, $1; nonresident, $10 (1917, No. 267). A special license (fee, $10) is required for trapping beavers. Such license permits the taking of 15 beavers, not more than 4 from a single colony. Unlawful to destroy beaver houses or dams or to have carcass or skin in possession without license seal attached (1911, No. 206). Unlawful to molest dens of fur animals or to use spears, explosives, chemicals, mechanical devices, or smokers to drive animals from their holes or homes; unlawful to destroy beaver, muskrat, or skunk den or home, to shoot muskrats, or to set a trap within 6 feet of a muskrat house or hole, or to possess carcass or skin of fur animal killed in close season (1917, ch. 186). Fur animals, except beavers, may be destroyed on one's own premises to protect property (1909, No. 183). Unlawful to trap on State game refuges (1913, No. 360).

Open seasons.—Beaver (under special license), November 1 to May 14; muskrat, skunk, otter, mink, fisher, marten, and raccoon, November 16 to March 14 (1917, No. 186). No close season for wolf, fox, lynx, and wildcat.

Propagation.—Annual license (fee, $5) required to engage in raising fur animals. Live animals and skins of animals raised in captivity must be tagged (fee, 5 cents for each tag) (1917, No. 311).

Bounties.—Wolf, $35; wolf cub under 6 months, $15; coyote, same as wolf; wildcat or lynx, $5; fox, $1; weasel, hawk, or owl, 50 cents; paid by county, half refunded by State. Boards of supervisors may pay additional bounties (1917, No. 315).

MINNESOTA.

Trapping.—Unlawful to molest or destroy muskrat, mink, or beaver house or den at any time or to hunt these animals with dog, or dogs, provided, that in the open season for muskrats their houses may be opened to set traps, but not in such manner as to injure them as habitations for muskrats. If any of these animals are damaging property the owner may obtain a permit to kill them and destroy their houses or dams. Nonresidents must obtain license to trap mink, beaver, muskrat, or otter; fee, $10. Skins or pelts legally taken may be possessed, bought, or sold at any time (1913, ch. 32, sec. 4796).

Open seasons.—No open season for beaver or otter; mink and muskrat, December 1 to April 15 (muskrats may not be killed by shooting February 15 to April 15); black bear, October 15 to March 1 (unlawful to take bear in steel trap); fisher, marten, and raccoon, October 15 to March 1 (1917, ch. 413).

Propagation.—Permits to breed or domesticate mink, muskrat, skunk, and raccoon are issued by the State game and fish commission; fee, 1 cent for each animal in possession. Also bond ($500) is required as guarantee that no wild animals will be captured during close season for other than breeding purposes. Persons having in lawful possession such fur-bearing animals have a property right therein, and it is unlawful for others to enter inclosures where the animals are confined, or molest them, under such penalties as would result were they ordinary domestic live stock (1913, ch. 32, sec. 4797).

Bounties.—No State appropriation for 1917–18. County or town boards may offer bounty on wolf, gopher, ground squirrel, groundhog, rattlesnake, crow, or blackbird (1909, ch. 48; 1911, ch. 220).

MISSISSIPPI.

Trapping.—No legal restrictions.[1]

Open seasons.—Bear, November 1 to end of February (Code, sec. 2324).

Propagation.—No legal restrictions.

Bounties.—None paid.

MISSOURI.

Trapping.—Wild fur-bearing animals may be destroyed at any time and in any way to protect premises from their depredations (Rev. Stat. 1909, sec. 6521a). Unlawful to sell or offer for sale pelts of fur animals taken out of season (1913, p. 348). Written permission required to trap on lands of another (1913, p. 224). Use of poison prohibited in taking any protected animal (1915, H. B. 605).

Open seasons.—All fur animals, December 1 to February 1 (sec. 6521a as amended, 1917).

Propagation.—Permits to capture for propagating purposes may be obtained from the State game and fish commissioner.

Bounties.—Adult wolf or coyote, $6; young wolf or young coyote, $3; paid by county and one-half refunded by State (sec. 10586).

MONTANA.

Trapping.—License (fee, $1.50) required for trapping, except for wolves, coyotes, and mountain lions. Special license (fee, $10) required for trapping beavers, and permit required to sell beaver skins. Special license (fee, $5) required for trapping on State game preserves. Unlawful to chase bear with dog or dogs (1917, ch. 173).

Open season.—No close season for fur animals, except beaver. Beavers may be taken only under a license; but under special conditions a permit may be obtained to kill beavers that are destroying property; proceeds of sale of pelts so taken to be placed to the credit of the State game fund (1917, ch. 173).

Propagation.—No legal restrictions.

Bounties.—Grown wolf, $15; wolf pup, coyote, or coyote pup, $2.50; mountain lion, $10; paid from State bounty fund raised by tax on live stock (1917, ch. 59).

NEBRASKA.

Trapping.—Unlawful to trap on premises of another without consent of owner (Code, sec. 2668).

Open seasons.—Muskrat, mink, raccoon, opossum, and otter (on premises of another), November 1 to February 15 (1917, ch. 54). Unlawful to destroy muskrat houses on premises of another. Beaver, no open season, but if the animals are damaging property a permit to destroy them may be obtained from the State game and fish commission (Code, sec. 2668). No close season for other fur animals; any except beavers may be taken at any time on one's own premises.

Propagation.—No legal restrictions.

Bounties.—Such counties as have at any general election voted to pay bounties, pay for wolf, $3; wildcat or coyote, $1; mountain lion, $3 (R. S., 1913, secs. 478–484).

NEVADA.

Trapping.—No legal restrictions.

Open seasons.—No close season except on beavers, which may not be taken until January 1, 1920 (1917, ch. 239).

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[1] The act for protection of game and fur animals (1916, ch. 99) was defeated by referendum vote.

Propagation.—License (fee, $10, paid annually to county) required from those who wish to propagate game or fur animals (except beaver). Animals on breeder's own lands may be taken at any time for propagation, and those held in captivity by holder of license may be sold at any time. No bounty may be collected on noxious species raised in captivity (1915, ch. 256).

Bounties.—Mountain lion, $5; lynx or wildcat, $2; paid by county (1917, ch. 66). Counties pay bounty of 1½ cents each for pocket gophers when at least 100 heads are presented at one time (1893, ch. 20).

The state board of live-stock commissioners is authorized to pay bounty from funds derived from tax on horses, cattle, and hogs. The rewards are, for coyote, coyote pup, wildcat, or lynx, 75 cents each; mountain lion, $5 (1915, ch. 268).[1]

The State board of sheep commissioners is authorized to pay bounty from funds derived from tax on sheep, the payments being the same as those made by the board of live-stock commissioners (1915, ch. 247).[1]

NEW HAMPSHIRE.

Trapping.—Fur-bearing animals defined as beaver, otter, marten, sable, mink, raccoon, fisher, fox, skunk, and muskrat. The right of anyone to kill predatory fur animals at any time when destroying domestic animals or fowls is granted. Skins legally taken may be bought or sold at any time. No person may destroy a muskrat house or set a trap therein, thereon, or at the entrance thereof. No person may trap upon lands of which he is not owner or lessee. All traps must be legibly marked or stamped with trapper's name, and must be visited at least once in 24 hours. It is an offense punishable by a fine to take traps of another or remove fur animals from them. Unlawful to use spring gun, snare, or poison in taking fur animals. Bear traps must be safeguarded in a substantial manner. License for trapping, except on private lands, is required; fee, resident, $1; nonresident, $15 (1915, ch. 133). Trappers are liable for any damage to domestic animals by traps (1917, ch. 184).

Open seasons.—All fur-bearing animals, except beaver, November 1 to February 28 (29). No open season for beaver. Raccoons and foxes may be taken by use of dog and gun during October (1915, ch. 133).

Propagation.—Permit (fee, $2) required to propagate fur animals, game, or fish (1917, ch. 184).

Bounties.—Bear, $5 (1895, ch. 121); hedgehog, 20 cents (1911, ch. 93); wild cat, $2 (1915, ch. 133); paid by State.

NEW JERSEY.

Trapping.—Skunks, minks, muskrats, and otters may not be taken in close season, except that muskrats may be destroyed by owner of canal or dam which they are destroying. Muskrats may be taken by trap only, except in Salem County, above Mill Creek, where they may be taken in open season by firearms and light. It is unlawful to disturb the lodge or nesting chamber of muskrats, to molest traps set by another, or to appropriate or take animals caught in such traps (1913, ch. 126, 161).

Open seasons.—Skunk, mink, muskrat, and otter, November 15 to April 1 (1913, ch. 126); raccoon, October 1 to December 15 (1915, ch. 216). Beaver, unlawful to trap, take, kill, or have in possession at any time (1903, ch. 264). The board of fish and game commissioners may grant permits to hunt foxes with hound and firearms from the last day of the open season for game (December 15) to March 31 (1913, ch. 157).

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[1] No bounties have been paid under the provisions of ch. 247 and 268.

Propagation.—No restrictions except those imposed by close seasons, during which wild animals may not be taken for breeding purposes.

Bounties.—Fox, $3; paid by counties (1902, ch. 112, amended by 1918, ch. 179).

NEW MEXICO.

Trapping.—No legal restrictions.

Open seasons.—No close season for fur animals, except beavers, which are protected at all times.

Propagation.—No restriction other than that respecting the capture of beavers.

Bounties.—Coyote, wildcat, or lynx, $2; wolf, $15; panther or mountain lion, $10; paid from county wild-animal fund, raised by tax on property (1909, ch. 104).

NEW YORK.

Trapping.—License required for hunting or trapping; fee, resident, $1.10; nonresident, $10. Muskrat houses may not be molested, injured, or disturbed, nor the animals shot at any time. Skunks may not be taken by digging or driving them from dens by chemicals; if injuring property, they may be taken at any time and in any manner (1917, ch. 486). Unlawful to set traps during close season (1917, ch. 170).

Open seasons.—Mink, sable, and raccoon, November 10 to March 15 (raccoon may be taken otherwise than by trapping, October 6 to March 15) (1917, ch. 374); skunk, November 10 to February 10; muskrat, November 10 to April 20. No open season for beaver (1914, ch. 92).

Propagation.—All protected fur animals may be kept alive in captivity for propagation and sale, provided a license be obtained from the conservation commission (fee, $5). No fur-bearing animals may be kept which are taken wild during close season for such animals (unless taken under license), nor may they be disposed of during close season (1914, ch. 92). The conservation commission is authorized to issue license to capture animals for propagation; fee for permit, $1 (1918, ch. 282).

Bounties.—Panther, $20, paid by State; none paid since May, 1884.

NORTH CAROLINA.

Trapping.—Otters, muskrats, or minks may not be trapped nor their skins sold by anyone who has not resided in the State at least two years (1905, ch. 394). Trappers require license in many counties.[1]

Open seasons.—Open seasons for hunting and trapping are fixed by local laws; more than half of the 100 counties have local laws relating to fur animals.

Propagation.—No legal restrictions.

Bounties.—None now paid by the State.

Local trapping regulations.—The following local regulations are in force (October, 1917):[2]

Alamance County.—Opossum, open season, October 1 to January 31 (sec. 1883): fox, same open season. Unlawful to carry fox out of State in close season (1911, ch. 654). A misdemeanor to take foxes save only with dogs or dog (1909, ch. 616).

Alexander County.—Opossum, open season, November 1 to February 28 (29) (1917, ch. 250).

Alleghany County.—Fox, open season, October 1 to February 28 (29) (1915, ch. 274).

Anson County.—Fox, open season, August 1 to March 31 (1911, ch. 621). Opossum and raccoon, open season, November 20 to January 19. License required, except by landowner on his own lands (1917, ch. 474).

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[1] For information about licenses application may be made to the clerk of any county.

[2] The references are to public local laws of various years or to sections of Pell's Revisal of 1913.

Ashe County.—All fur animals, open season, November 1 to January 31 (1913, ch. 560).

Bertie County.—Opossum and raccoon, open season, October 1 to January 31 (1915, ch. 555). Written permission required to trap on lands of another (1917, ch. 53).

Bladen County.—Opossum and raccoon, open season, November 1 to January 30 (1911, ch. 123). Setting traps in Colly Township regulated (1909, ch. 436).

Buncombe County.—Unlawful to trap on lands of another (1913, ch. 560). Fox, open season, September 1 to February 28 (29) (1917, ch. 658).

Burke County.—Fox, close season in that part of the county lying south of Catawba River and Cleveland, March 1 to November 30, except when the animals are committing depredations (1907, ch. 388).

Caswell County.—Opossum, open season, October 1 to January 31 (sec. 1883).

Chatham County.—Opossum, open season, October 1 to January 31 (1911, ch. 756); fox, open season, September 1 to January 31 (1911, ch. 135).

Cherokee County.—Unlawful to hunt (except for foxes and wolves) on lands of another without written permission of owner or agent (1907, ch. 452).

Clay County.—All fur animals, open season, November 15 to February 14 (1917, ch. 395). Unlawful to set trap so as to catch live stock (1917, ch. 565).

Cleveland County.—Fox, open season, December 1 to February 28 (29) (1883 b).

Columbus County.—All fur animals, open season, January 1 to March 31, except in Bug Hill and Lee Townships, December 1 to February 28 (29). Steel traps of a spread of 14 inches or more may be used at any time provided notice of their setting is posted (1909, ch. 417). Permission required to trap on lands of another (1917, ch, 394).

Craven County.—Otter, mink, muskrat, raccoon, and skunk, open season, December 1 to March 31. Owner of property may kill at any time to protect such property (1915, ch. 37).

Cumberland County.—A bounty of $5 is paid for each bear killed in Cedar Creek and Beaver Dam Townships (1905, ch. 176).

Currituck County.—Otter, raccoon, opossum, mink, and muskrat, open season, November 1 to March 31 (1913, ch. 560). Unlawful to shoot otter or muskrat in open season after sunset or before sunrise on east side of Currituck Sound (1909, ch. 537).

Duplin County.—Fox, open season, September 15 to February 14 (1911, ch. 407).

Durham County.—Opossum, open season, October 1 to January 31 (sec. 1883).

Edgecombe County.—Opossum, open season, October 1 to December 31 (1911, ch. 189).

Forsyth County.—Opossum, open season, October 1 to January 31 (1913, ch. 560).

Franklin County.—Opossum, open season, October 1 to January 31 (sec. 1883); fox, October 15 to February 28 (29) (1913, ex. sess., No. 169).

Gates County.—All fur animals, open season, November 15 to March 31 (1911, ch. 745).

Graham County.—Opossum, open season, October 1 to January 31 (sec. 1883).

Granville County.—Fox (with gun or dog), open season, October 31 to February 1 (1917, ch. 598).

Greene County.—Opossum, open season, October 1 to January 31 (1907, ch. 598).

Guilford County.—Opossum, open season, October 1 to January 31 (sec. 1883).

Halifax County.—Raccoon and opossum, open season, November 15 to March 1; fox, September 15 to February 28 (29). Unlawful to trap on lands of another without permission (1913, ch. 591).

Harnett County.—Opossum, open season, October 1 to December 31 (sec. 1883).

Haywood County.—All fur animals (except bear), open season, November 15 to January 14. No close season on bear, and fur animals may be destroyed at any time when preying on poultry, pigs, or lambs (1913, ch. 366).

Henderson County.—Fur animals, except wildcat, opossum, and mole, are protected by a close season from March 15 to November 14 (1913, ch. 560). The board of county commissioners are authorized to add to the list of protected fur bearers, and fix the open season for killing them (1915, ch. 677). Trapping on lands of another without permission of owner or agent is unlawful (1915, ch. 135).

Hoke County.—Unlawful to hunt or trap on lands of another without permission. Nonresidents require license (fee, $15, unless for hunting or trapping deer, wild turkeys, or foxes, when the fee is $25) (1915, ch. 459).

Iredell County.—Opossum, open season, October 1 to February 28 (29) (1917, ch. 459).

Johnston County.—Opossum, open season, November 1 to February 28 (29) (1917, ch. 520).

Lee County.—Opossum, open season, October 1 to January 31; fox, August 15 to March 31 (1913, ch. 111).

Lenoir County.—Fox, open season, September 15 to February 14 (1917, ch. 673).

Lincoln County.—Opossum, open season, October 1 to December 31 (sec. 1883); fox, November 15 to January 31, except that when doing damage to fowls or other live stock, foxes may be killed at any time (1913, ch. 359).

McDowell County.—Opossum and raccoon, open season, October 15 to February 28 (29) (1913, ch. 70).

Macon County.—All fur animals, open season, November 15 to February 14 (1917, ch. 395).

Mecklenburg County.—Opossum, open season, October 1 to January 31; fox, November 15 to January 31. Foxes may be killed at any time if destroying property of value (1911, ch. 543).

Mitchell County.—Raccoon, October 15 to January 31 (1913, ch. 369). Bounty of 50 cents each on weasel, mink, and horned owl (1913, ex. sess., No. 99).

Montgomery County.—Opossum, open season, October 1 to December 31 (1911, ch. 102); fox, October 15 to January 14 (1911, ch. 291).

Moore County.—Opossum, open season, October 1 to January 31 (sec. 1883); fox, October 1 to February 28 (29) (1911, ch. 291); unlawful to carry fox out of State in close season.

New Hanover County.—Fox, open season, September 15 to February 14 (1917, ch. 673).

Onslow County.—Fox, open season, September 15 to February 14 (1917, ch. 673).

Orange County.—Opossum, open season, October 1 to January 31 (sec. 1883).

Pamlico County.—Opossum, open season, October 1 to January 31 (sec. 1883).

Pasquotank County.—Raccoon, opossum, mink, muskrat, wildcat, and bear, open season, November 1 to March 31 (1913, ch. 369).

Pender County.—Fox, open season, September 15 to February 14 (1911, ch. 407).

Polk County.—Opossum, open season, October 1 to January 31 (1915, ch. 454).

Randolph County.—Opossum, open season, October 1 to December 31 (1911, ch. 24).

Richmond County.—Raccoon, open season, September 1 to March 31 (sec. 1883a); fox, October 1 to February 28 (29) (may be taken only with dogs) (1913, ch. 520). Hunting license for pack of five or more dogs, $25.

Robeson County.—Otter, skunk, raccoon, mink, muskrat, and opossum, open season, October 1 to February 28 (29). Hunting license required to take except on one's own premises. Snares and traps unlawful (1917, ch. 537).

Rockingham County.—Opossum, open season, October 1 to January 31; may be destroyed at any time by landlord or renter to protect crops (1911, ch. 756). Unlawful to shoot or trap fox (1905, ch. 752).

Rutherford County.—Fox, open season (in three townships—Golden Valley, Logans Store, and Duncans Creek), November 1 to January 31; to be hunted with dogs only (1913, ch. 591). No close season in other townships.

Sampson County.—Fox, open season, September 15 to February 14 (1917, ch. 673). Opossum, open season, October 1 to February 28 (29) (1911, ch. 19).

Scotland County.—Open season for fox, August 15 to February 28 (29). Nonresident requires license (fee, $25) to hunt foxes (1917, ch. 57). Permission required to trap on lands of another.

Stokes County.—All fur animals, open season, September 1 to January 14; written permission required to trap on lands of another (1917, ch. 588).

Surry County.—Opossum, open season, October 1 to December 31 (1915, ch. 289).

Swain County.—Mink, otter, muskrat, skunk, raccoon, and opossum, open season, November 15 to February 14; owner of property may kill at any time to protect it (1915, ch. 772).

Vance County.—Fox, raccoon, opossum, open season, November 15 to February 28 (29); but may be run down and caught by dogs at any time (1913, ch. 718).

Wake County.—Raccoon and opossum, open season, October 1 to January 31 (1913, ch. 225).

Warren County.—Opossum, open season, October 1 to December 31 (1883).

Watauga County.—All fur animals (except mink and muskrat), open season, November 1 to March 14. They may be taken in open season only with dogs and gun, or either. Mink and muskrat not protected (1913, ch. 533).

Wayne County.—Fox, open season, September 15 to February 28 (29) (1917, ch. 673).

Wilkes County.—Opossum, open season, October 15 to February 28 (29) (at night); but may be shot at any time when killing fowls or pigs. Fox, open season, October 1 to February 14, except that they may be killed in close season when destroying fowls; may not be shot at any time except to protect property (1913, ch. 77).

Yadkin County.—Opossum, open season, October 1 to February 28 (29) (1911, ch. 71).

Yancy County.—Opossum, mink, otter, and raccoon, open season, November 1 to December 31 (1917, ch. 136).

NORTH DAKOTA.

Trapping.—A license is required to trap except on one's own lands; fee, resident, $1; nonresident, $25. The protected fur animals are mink, muskrat, otter, and beaver; but minks and muskrats may be killed at any time by owner of property destroyed by them. Muskrat houses are protected at all times (1915, H. B. 300).

Open seasons.—Mink and muskrat, November 16 to April 14; beaver and otter, January 10 to March 10. Only licensed trapper may take beaver, but not upon posted lands. Possession of green hides of mink or muskrat illegal after April 19 (1917, S. B. 74).

Propagation.—The State game and fish board issues permits to breed and domesticate protected birds and animals and also permits to ship them when raised in captivity. Annual reports are required of licensed breeders (1915, H. B. 300).

Bounties.—Wolf or coyote (killed within State), $2.50 each; paid from fund raised by direct taxation on all property (1903, ch. 207).

OHIO.

Trapping.—Written permission required to hunt or trap on lands of another (1917, H. B. 115). The close season for certain fur animals does not prohibit owners or tenants of land from destroying them to protect property. Digging out skunk dens or smoking the animals therefrom is unlawful, as is also the possession of green skunk pelts in close season (1913, H. B. 80).

Open seasons.—Raccoon, muskrat, mink, skunk, and opossum, November 15 to February 1; fox, October 2 to January 9. Protected animals may be destroyed by owner of premises (except on Sunday) when damaging property (1917, H. B. 109).

Propagation.—No restrictions, except those which prevent capture of wild stock in close season.

Bounties.—Townships pay a bounty of $1 each on certain hawks (1915, H. B. 79); 20 cents per dozen on English sparrows; and, under certain conditions, 10 cents each on ground hogs (P. & A. Code, 1912, secs. 5824–5827).

OKLAHOMA.

Trapping.—Unlawful to sell pelts of fur animals taken between March 1 and November 1 (1917, H. B. 542).

Open seasons.—No open season for otter or beaver. Other fur animals, November 1 to March 1 (1917, H. B. 542). No open season for bear in Comanche, Caddo, Kiowa, Major, and Blaine Counties (1915, ch. 258).

Propagation.—The State game warden issues permits to propagate fur-bearing animals, game, and fish; cost $2, together with fees for tagging. Licensed breeders may sell and transport animals raised in preserves under rules prescribed by the warden (1915, ch. 185).

Bounties.—County commissioners are authorized to offer bounty on gray wolf ($3) and coyote ($1) (1890, S. B. 458). Bounties on hawks, crows, etc., paid by counties (not to exceed $200 a year in any county) are refunded to county from State game fund (1917, H. B. 542).

OREGON.

Trapping.—License (fee, $1.50) is required of all persons over 16 years of age to trap on lands not their own. No flesh of game animal or bird may be used to bait traps. Unlawful to remove or disturb traps of a licensed trapper on public domain or on lands where he has permission to trap. Licensed trappers are required to make annual reports of number of animals caught and receipts for fur sold. If beavers or other fur animals damage property, permits to kill them may be obtained from the State board of fish and game commissioners. Skins of such animals are the property of the State, to be sold and the proceeds used in paying for damage to property. Unlawful to destroy muskrat house, except where it obstructs ditch or watercourse (1913, ch. 282).

Open seasons.—Mink, otter, fisher, marten, and muskrat, November 1 to February 28, inclusive. No open season for beaver, except in Benton and Marion Counties, where no close season is provided (1917, ch. 340). No open season for fur animals on State game preserve (1913, ch. 232).

Propagation.—Permits (fee, $2) to keep fur-bearing animals may be obtained from the State board. No wild fur animals may be taken for propagating purposes in close season nor may those held in captivity under permit be sold in that season. Yearly reports to the State board are required (1913, ch. 232).

Bounties.—Coyote or coyote pup, $3 (bounty on adult female to increase $1 each year); gray or black wolf, $5; wolf pup, $2.50; bobcat, wildcat, or lynx, $2.50; mountain lion, $10; seal or seal pup, $3; paid by county and half refunded by the State (1917, ch. 133). The State board is empowered to pay additional bounties, at its discretion, on any predatory animal in order to protect game (1913, ch. 232); under this act the State board now pays for wolf, $20; for cougar, $15. Several counties are authorized by law to levy a special tax and pay bounties on moles, rabbits, or gophers (1917).

PENNSYLVANIA.

Trapping.—Nonresident trapper requires license (fee, $10) (1917, No. 86). Unlawful to trap bears, and only one may be killed in a season. No steel traps larger than No. 3 size may be used for trapping wildcats or other fur animals. Resident requires no license for trapping, but hunting licenses required for killing raccoons or bears, which are regarded as "game" animals.

Open seasons.—Bear, October 15 to December 15; raccoon, September 1 to December 31. No open season for beaver. Foxes may not be trapped, shot, snared, or poisoned in Delaware County (1915, P. L., 146).

Propagation.—No legal restrictions on raising fur animals, except that possession and breeding of ferrets is unlawful except under license from the State board of game commissioners; fee for license to breed and sell ferrets, $25; to possess a ferret without breeding, $1 (1915, P. L., 146).

Bounties.—Wildcat, $6; fox, $2; mink, $1; weasel, $1; paid from special fund created by setting aside one-half the receipts by the board of game commissioners from gun licenses, fines, etc. (1915, P. L., 126).

PORTO RICO.

Porto Rico has no wild fur animals.

RHODE ISLAND.

Trapping.—Hunting license is required for trapping, except on one's own lands; fee, resident, $1; nonresident, $10; alien, $15; together with an additional fee of 15 cents for issuing license. Unlawful to trap on posted lands or on lands of another without written permission. Unlawful to set wire snares, or to use steel traps with teeth or with spread over 6 inches, or choke traps with greater opening than 6 inches. Traps must be concealed so as not to endanger domestic animals and must be visited at least once in 24 hours.

Open seasons.—Skunk, muskrat, raccoon, and mink, November 1 to April 15 (1916, ch. 1399). Landowners may kill protected animals on their own lands at any time (1915, ch. 1230).

Propagation.—No legal restrictions.

Bounties.—Fox, $3; crow and certain hawks and owls, 25 cents; paid by State.

SOUTH CAROLINA.

Trapping.—Unlawful to hunt or trap on lands of another without his consent. Unlawful at any time to shoot or trap foxes in York, Union, Chesterfield, Edgefield, Lee, Cherokee, Chester. Fairfield, Lancaster, Richland, Abbeville, Calhoun, Sumter, Orangeburg and Marlboro Counties. Nonresidents (except freeholders) require license (fee $5) to chase foxes in Chester, York, Cherokee, and Union Counties (C. Code, sec. 740, acts 1916, Nos. 427 and 435).

Open seasons.—*Horry County*—Fox, raccoon, opossum, mink, otter, and skunk, November 15 to February 15 (1918, No. 404). *Chester County*—Fox, August 15 to February 28 (29); other counties named in preceding paragraph, fox. September 1 to February 14 (C. Code, sec. 740, acts 1916, Nos. 427 and 435).

Propagation.—No legal restrictions.

Bounties.—None paid.

SOUTH DAKOTA.

Trapping.—License (fee, $5) required for taking mink, muskrat, otter, or beaver, except on trapper's own lands. Boys under 18 years of age do not require license (1917, ch. 245). Nonresident trapping license, $10 (1909, ch. 183). Skins of fur animals killed out of season may not be bought or sold (1909, ch. 240).

Open seasons.—Mink, muskrat, otter, and beaver, December 1 to March 31 (1917, ch. 245).

Propagation.—No restrictions, except that protected animals may not be taken for breeding purposes in close season.

Bounties.—Counties shall pay $4 for coyote and $8 for wolf, killed within the county (1917, ch. 149).

TENNESSEE.

Trapping.—Owner of land may hunt or trap on such land at any time; others may do so only with written consent of owner. Steel traps must be placed at least 12 inches within the entrance to a hole, cave, den, or hollow log. Traps and deadfalls must be inspected within each 36 hours, and captured animals removed (1915, ch. 152); does not apply to trapping wildcats in Lauderdale County (1917, ch. 205).

Open seasons.—For trapping fur bearers off one's own land, from noon October 15 to noon January 15 (1915, ch. 152).

Propagation.—No legal restrictions.

Bounties.—Wolf or panther, $2 certificate issued by county court, the amount to be applied on payment of taxes (1889, ch. 200).

Local laws of counties:

Blount and Union Counties.—Unlawful to shoot fox, to trap or injure young foxes, or to destroy their dens (1917, chs. 315, 594).

Carter and Johnson Counties.—Unlawful to trap, shoot, or kill fox or to destroy fox den, except near farm buildings when they destroy fowls or live stock (1915, ch. 593).

Claiborne, Grainger, Davidson, Roane, and Shelby Counties.—Unlawful to set a trap more than 200 yards from trapper's residence (1915, chs. 413, 497; 1917, ch. 724).

Davidson, Robertson, and Shelby Counties.—Open season for beaver, muskrat, fox, mink, raccoon, skunk, and opossum, September 1 to January 31. Sale of these animals or their skins restricted to from November 1 to January 31 (1915, ch. 691).

Dyer County.—Open season for raccoon, mink, and otter, October 1 to February 15 (1911, ch. 638).

Meigs and Rhea Counties.—Same provisions about foxes as in Blount and Union Counties, but also sale of the animals or their pelts is prohibited (1917, ch. 656).

Smith County.—Open season for trapping fur animals, October 15 to February 15 (1917, ch. 693).

Warren County.—Open season for opossum, raccoon, and other fur animals, November 1 to February 28 (29), (1917, ch. 256).

TEXAS.

Trapping.—No license required for trapping, but on posted lands consent of owner is necessary (1915, ch. 47).

Open seasons.—No close season for fur animals.

Propagation.—No legal restrictions.

Bounties.—None paid by State.

UTAH.

Trapping.—No license required for trapping. Aliens other than homesteaders are not allowed to hunt or trap in the State (1917, ch. 95).

Open seasons.—Beaver and otter protected at all times. If beavers destroy property, the State fish and game commissioner may give permit to kill, but hides must be delivered to the commissioner to be sold for benefit of game fund (1917, ch. 79). No close season on other fur animals.

Propagation.—No legal restrictions.

Bounties.—Wolf, $50; bear, mountain lion, or cougar, $25; coyote, lynx, or bobcat, $2.50; jack rabbit or pocket gopher, 5 cents; prairie-dog or ground squirrel, 3 cents; paid from State bounty fund, raised by direct appropriation and a tax of 5 mills on live stock (1917, ch. 125).

VERMONT.

Trapping.—License is required for trapping, except on one's own land; fee, resident, 60 cents; nonresident, $10.50. Persons trapping on inclosed lands of another must inform owner of location of traps and must visit traps at least once in 24 hours. The use of spring guns is prohibited, and bear traps must be carefully safeguarded. Skins of fur animals legally taken may be bought or sold at any time. Unlawful to open or destroy a muskrat house or to place a trap at its entrance. Unlawful to dig skunks from dens or to drive them out by use of smoke or chemicals.

Open seasons.—Mink, otter, and muskrat, November 1 to April 30; marten, raccoon, fisher, and skunk, October 20 to March 31; fox, October 20 to April 1 (may be taken otherwise than by trapping at any time). No open season for beaver (1915, ch. 201).

Propagation.—The State fish and game commissioner issues special permits for propagating fur and game animals (fee, $2 and expense of tagging). Animals bred on fur farms may be sold and transported alive at all times when bearing the identification tags prescribed by the commissioner (1915, ch. 231).

Bounties.—Hedgehog (porcupine), 15 cents; paid by State (1912, ch. 207). Towns pay $5 bounty on bay lynx or bobcat (1915, ch. 185).

Local laws:

Addison County.—Open season for muskrat, March 1 to April 30.

Franklin County.—Open seasons: Muskrat, November 1 to April 30; fox, November 1 to February 28, (29); other fur animals, November 1 to March 31 (1917, No. 219).

Shores of Lake Champlain in Rutland County, Poultney River below Carvers Falls, and shores of Lake Memphremagog in Orleans County.—Open season for mink, muskrat, or otter, January 1 to April 30 (1917, No. 218).

VIRGINIA.

Trapping.—The following applies to any county after adoption by the board of supervisors: Trapping for fur animals on lands of another is unlawful except from noon of October 15 to noon of January 15, and then only with written permission of landowner, which permission the trapper must have on his person when trapping. He must visit traps at least once in 36 hours and is liable for any damage such traps may do to domestic animals. Landowner may trap or kill fur animals on his own lands at any time (1916, ch. 376).

Open seasons.—(Applies to any county adopting the law). All fur animals on lands of another, noon of October 15 to noon of January 15 (1916, ch. 376).

Propagation.—License required (fee, $25) to raise game or fur animals (1918, ch. 266).

Bounties.—Boards of supervisors of counties are authorized to pay a bounty of 50 cents each for goshawk and cooper's hawk (1918, ch. 23).

Local trapping regulations.—The following provisions are in force:

Culpeper County.—Unlawful in Jefferson magisterial district to trap foxes except in November and December. Traps set for foxes must be visited daily to release any dog that may be caught (1912, ch. 257).

Fauquier and Loudoun Counties.—Unlawful to take foxes April 1 to August 31, except by owner or tenant of land to protect property. Unlawful in open season to shoot, trap, or poison foxes except on written authority of a landowner (1914, ch. 141).

Fauquier County.—Supervisors may pay 50 cents bounty on goshawk and cooper's hawk, from surplus derived from dog tax (1918, ch. 35).

Halifax County.—Opossum, open season, October 15 to January 31, (1892, ch. 40).

King George County.—Muskrat, open season, December 20 to March 31 (1918, ch. 174).

Loudoun County.—License (fee, $2.50) required to trap mink, muskrat, skunk, opossum, and raccoon on lands of another. Open season for mink, muskrat, and skunk, November 1 to February 28 (29); for opossum and raccoon, October 1 to February 28 (29) (1916, ch. 23).

Nansemond County.—Mink, otter, and muskrat, open season, January 1 to March 31 (1914, ch. 223).

Patrick County.—Wild raccoon or opossum, open season, October 15 to March 14; gray fox, September 15 to March 14 (1912, ch. 247).

Princess Anne County.—Unlawful to catch, trap, or kill mink, muskrat, or otter for profit, except from November 1 to March 14 (1910, ch. 191).

Rappahannock County.—Unlawful to trap or hunt on lands of another without written permit from owner (1910, ch. 361).

Rockingham County.—Bounty on crows authorized (1918, ch. 201).

Amherst, Essex, King George, and *Loudoun Counties* are authorized to pay bounty of 50 cents each on certain hawks (1916, chs. 7, 124, 336).

WASHINGTON.

Trapping.—Trapping license (fee, $5) required. No steel trap larger than No. 4 may be used unless a notice in the English language on a large placard is placed above the trap; this requirement does not apply to trapping coyotes, muskrats, minks, skunks, martens, civet cats, and weasels (1917, ch. 164).

Open seasons.—Bear, September 1 to April 30; at any time when found destroying domestic animals (1917, ch. 164). No open season for beaver (R. & B. Code 1910, sec. 5395). No close season for other fur animals.

Propagation.—No legal restrictions.

Bounties.—Mountain lion or cougar, $20; lynx or wildcat, $5; coyote, $1; timber wolf, $15 (1909, ch. 193); seal or sea lion in Columbia River district, $3 (1917, ch. 164); paid by State. Counties are permitted to pay additional rewards for destroying these animals, and also bounties on bear, muskrat, and squirrel (R. & B. Code 1910, secs. 3587–3592).

WEST VIRGINIA.

Trapping.—An owner of lands or his agent or tenant may hunt or kill protected fur animals on such lands at any time, but it is unlawful to set or maintain a snare or trap upon lands of another without express permission of owner or tenant. Unlawful to set a steel or spring bear trap on lands of another. Hunting license is required for trapping; fee, resident, $3; nonresident, $16.

Open seasons.—Red fox, raccoon, mink, and skunk, November 1 to December 31 (1915, ch. 14). Any county may by majority vote provide a perpetual close season on skunk (1903, ch. 44).

Propagation.—No restriction on possession or sale, but animals may not be taken for breeding purposes in close season except on lands owned or tenanted by the breeder.

Bounties.—Wildcat, bobcat, or catamount, $5; crow, 10 cents; certain hawks and owls, 25 cents; paid from forest, game, and fish protection fund (1915, ch. 14).

WISCONSIN.

Trapping.—License required for trapping; fee, resident, $1; nonresident, $25; report required from licensed trapper. Unlawful to take fisher, marten, mink, or muskrat with the aid of spear, gun, or dog; to take rabbit with ferret; to disturb or molest muskrat houses, or beaver houses or beaver dams, or raccoon den trees for the purpose of capturing raccoons; or to set traps within 500 feet of any beaver dam or beaver house. Steel traps may be used for taking fur animals in open season. The possession of green skins of any fur-bearing animal during close season is unlawful, as is also the possession at any time of the skin of a fisher, marten, mink, or muskrat which shows that the animal had been shot or speared.

Owners of cranberry marshes may at any time destroy muskrats to protect dams, but they may not sell, barter, or give away the skins of such animals killed during close season.

Beavers and otters are protected at all times except beavers in 3 counties. If beavers damage property, they may be captured and removed under the direction of the State conservation commission (1917, ch. 668).

Open seasons.—Beaver in Price, Rusk, and Sawyer Counties, December 1 to December 31 (1917, 1918); black bear, November 10 to December 1; fisher, marten, mink, and skunk, November 15 to February 1; raccoon, October 15 to January 1 (bag limit 5 a day); muskrat (18 counties), October 15 to April 20 (53 counties), October 15 to April 10 (1917, ch. 668).

Propagation.—Breeders of protected game or fur animals must obtain a license from the State conservation commission (fee, $5) and make annual reports to the commission. The commission will furnish tags at cost of same to enable breeders to ship, sell, and transport animals or skins from their establishments (1917, ch. 668).

Bounties.—Wolf cub taken between March 1 and November 1, $4; mature wolf killed at any time, $10; fox, $2; paid by county. County boards may increase these rewards, but no county may pay more than $6 for killing a wolf cub. The State treasurer duplicates all county awards, thus doubling the above bounties. Poisons may be used for destroying animals for bounty between December 1 and March 1, but notice of putting out baits must be posted, and they may not be placed within 80 rods of a dwelling house (1917, ch. 676). County boards may offer bounty on crow, hen hawk, pocket gopher, streaked gopher, English sparrow, blackbird, or rattlesnake (1913, ch. 773).

WYOMING.

Trapping.—Unlawful to trap game animals or birds or to use their flesh as trap bait for predatory animals. Unlawful to trap on State game preserves without permit (fee, $5) (1915, ch. 91), and for anyone not employed by the United States Department of Agriculture to trap in national forests within the State without first obtaining a permit (fee, $5) from the State game warden (C. S. 1910, Mullen, sec. 2786). Nonresident of State must secure a special license (fee, $10) to hunt, pursue, trap, or kill bears (sec. 2748).

Open seasons.—No close season on fur-bearing animals except beavers, which may not be taken at any time until September 15, 1919, but if they damage real estate the owner may obtain permit to destroy them (sec. 2769).

Propagation.—No legal restrictions.

Bounties.—Coyote, $1.50; bobcat, $1; adult gray or black wolf, $15; gray or black wolf pup, $10; mountain lion, $5; paid from State appropriations (1917, ch. 85).

LAWS OF CANADA.

ALBERTA.

[From "Game act," as amended to May 1, 1918.]

Trapping.—Nonresident requires license to trap; fee, $25. Unlawful to use poison for taking fur-bearing animals; to destroy, partially destroy, or leave open any muskrat or beaver house; or to destroy a beaver dam, unless authorized to do so by the lieutenant governor in council, who may also authorize the killing of beavers or other fur animals when such killing is deemed to be in the public interest. Export of unprime skins or pelts is forbidden, unless by permit from the minister of agriculture. No fox may be trapped or taken alive for export. Every company, firm, or person engaged in the fur trade must make annual returns of the number of skins bought or sold (game act, 1915).

Open seasons.—Mink, fisher, and marten, November 1 to March 31; otter and muskrat, November 1 to April 30. No open season for beaver until December 31, 1920, unless locally by order of the lieutenant governor in council (game act, 1915).

Propagation.—Manager of fur farm required to make reports January 1 and July 1 of each year. Export of live animals from fur farms allowed only on permit from the minister of agriculture. Permit, with fees, required to export live muskrats, minks, fishers, martens, otters, or beavers whether raised on a fur farm or otherwise (orders in council).

Bounties.—The council of any rural municipality is authorized to offer a bounty on wolves.

BRITISH COLUMBIA.

[From "Game act," as amended to May 1, 1918.]

Trapping.—License required to trap off one's own lands; fee, resident, $10; nonresident, $25. A licensed trapper who first occupies a trap line prior to November 14 is protected against other trappers. License must be returned within two months after it expires, with a statement of number of fur animals of each kind taken. It is unlawful to touch or interfere with traps set by a licensed trapper, to trap on inclosed or cultivated land without permission of owner, or to permit traps to remain set after close of season. Possession or export of pelts is allowed only during open season and for two months thereafter (three months, north of fifty-second parallel), except by special permit. Special license to hunt bears (fee, $25, and additional fee of $15 to $25 for each bear killed) is required of a nonresident.

Open seasons.—Fox, November 1 to March 16; all other fur animals (beaver, marten, fisher, mink, muskrat, otter, raccoon, and weasel, or ermine), November 1 to April 30 (orders in council, August 4, 1917).

Propagation.—A permit to propagate fur-bearing animals is required. Breeder must keep a record of transactions as to purchases and sales of stock, which record must be open to inspection of any game warden (1914, ch. 33). Live foxes may be exported only under permit; fee, $100. Special license is required to take foxes or other fur animals in close season.

Bounties.—Rates fixed from time to time by lieutenant governor in council.

MANITOBA.

[From "Game protection act," as amended to 1917.]

Trapping.—A license is required to trap, except on one's own land; fee, resident, 50 cents; nonresident Canadian citizen, $25; nonresident alien, $100. Report giving number of animals of each kind taken under license is required to be made between June 1 and July 1. Persons trading in furs must be licensed (fee, resident, $5; nonresident, $50) and are required to make annual returns before August 1. Unlawful to trap in Provincial game preserves, to trap on cultivated or inclosed lands without permission of owner, to destroy a muskrat or beaver house, to use poison in taking fur animals, or to export unprime skins. Poison may not be used to capture wolves for bounty.

Open seasons.—South of fifty-third parallel: Fisher, pekan, sable, marten, and mink, November 1 to March 31; otter and beaver, no open season; fox and lynx, no close season. *North of fifty-third parallel:* Fisher, pekan, sable, marten, and mink, November 1 to March 31; otter and beaver, November 1 to April 30; fox and lynx, November 1 to February 28 (29).

Muskrat, *south of fifty-first parallel:* March 1 to May 14; *north of fifty-first parallel:* October 20 to November 30, and March 1 to May 14. Unlawful to shoot or spear muskrats.

Propagation.—No legal restrictions except that a special permit must be obtained to export live fur animals; fee, for black or silver fox, $100; for other fox, $15; for live otter, $25; for any other fur animal, $5.

Bounties.—Timber wolf, $5; other wolf, $2; half is refunded to municipality by the Provincial treasurer (1915, ch. 95).

NEW BRUNSWICK.

[From "Game act of 1909," as amended to 1918.]

Trapping.—Nonresidents require a license (fee, $25) for trapping. A license is also required to deal in, buy, sell, cure, or tan the skins of fur-bearing animals. The digging out of foxes from their homes or earth burrows is prohibited at all times. Unlawful to possess green skins or carcasses of protected fur animals in close season.

Open seasons.—Mink, otter, and fisher, November 1 to March 31; fox, October 1 to February 28 (29); muskrat, noon of March 25 to noon of May 15. Beaver and sable, close season to July 1, 1919. The surveyor general, when satisfied that a number of beavers may be taken from any stream without injury to the supply, may issue a special license for taking them; fee, $2 for each animal taken.

Propagation.—Permits to capture wild fur-bearing animals for propagation within the Province may be obtained from the surveyor general, who fixes the fee for such permit.

Bounties.—Wildcat (killed within the Province), $2; porcupine, 50 cents; hawks and owls, 25 cents each; paid by the surveyor general.

NORTHWEST TERRITORIES.

[From "Game Laws," as amended to September, 1917.]

Trapping.—License (fee, $2) required of all trappers except native Indians. License (fee, $5) required for trading in furs. Use of poison prohibited in taking fur animals. Export of unprime or low-grade furs forbidden.

Open seasons.—Mink, fisher, and marten, November 1 to May 14; otter, beaver, and muskrat, October 1 to May 14; white fox, November 15 to March 31.

Propagation.—Permits may be obtained to take live fur animals for propagation.

Bounties.—None paid.

NOVA SCOTIA.

Trapping.—Nonresident requires a license (fee, $30) to take fur-bearing animals, which are included in the term "game." Unlawful to take any protected fur animal (unless under a permit) from a burrow or den by smoking or digging; to take fur animal by use of poison; to damage or molest a beaver dam or house, or a muskrat house, or set snare or trap within 25 feet of the latter; or to have in possession the green hide or pelt of a fur animal taken out of season (1915, ch. 38).

Open seasons.—No open season for beaver or marten. Mink, otter, fox, raccoon, muskrat, and all other fur-bearing animals (except bear, wolf, and wildcat, which are not protected), November 1 to January 31 (1915, ch. 38).

Propagation.—Permits to take wild animals may be obtained from the board of game commissioners under such restrictions as they may require. Unlawful to keep fur-bearing animals in captivity for breeding purposes without a permit from the chief game commissioner; fee $2 for each kind of animal kept, payable annually. Reports are required annually on September 30. Inclosures for fur animals are protected from trespass (1912, ch. 59).

Bounties.—None paid.

ONTARIO.

[From Rev. Stat., ch. 262, as amended to 1918.]

Trapping.—License to trap required except to take wolf and fox or to trap on one's own land; fee, resident, $5; nonresident, $50. License (fee for resident, $10; for nonresident, $25) is required of all fur dealers or traders. Dealers may obtain a permit to hold furs during close season. Possession of unprime skins is illegal. Muskrats may not be shot or speared at any time. Muskrat houses are protected at all times except when the animals are injuring property. Beavers, when damaging property, may be destroyed by game overseer under special authorization from the superintendent of game fisheries.

Open seasons.—Mink, fisher, and marten, November 1 to April 30; muskrat, north of French and Mattawa Rivers, April 1 to May 20; south of said rivers, March 1 to April 20. Beavers and otters may be taken by residents of the Province only under license and special restrictions, from November 1 to March 31.

Propagation.—A permit is required of breeders of game or fur animals. Licensed fur breeders may sell live animals or skins at any time. The Minister may grant permits to take fur animals during the close season for propagating and scientific purposes.

Bounties.—Gray timber wolf, $20; other wolf, $5; paid by county, but Provincial treasurer refunds 40 per cent to county. Provincial treasurer pays entire bounty in unorganized counties (1916 wolf bounty act).

PRINCE EDWARD ISLAND.

Trapping.—Nonresident requires license (fee, $50) for trapping. Unlawful to put out poisoned baits for foxes or other animals.

Open seasons.—Marten, mink, muskrat, and otter, November 1 to March 31; beaver, no open season, and the animals or their pelts taken in the Province may not be sold (1917, ch. 11).

Propagation.—Several special acts of the Provincial legislature regulate fox ranching on the island. The animals are assessed for taxation (1913, ch. 9); ranches are protected from trespass, under heavy penalties (1913, ch. 10; and incomes from ranches are taxed (1917, ch. 3).

Bounties.—None paid.

QUEBEC.

[From Rev. Stat., 1909, ch. 8, as amended to 1918.]

Trapping.—Use of poisons in taking fur animals prohibited. Reports are required of all persons engaged in the fur trade (buying, selling, or taking fur animals) before September 1 of each year. Royalties must be paid on fur animals or furs shipped out of the Province.

Open seasons.—Mink, otter, marten, fisher (pekan), raccoon, skunk, or any other fur-bearing animal not excepted in this article, November 1 to March 31; beaver, November 1 to March 31; muskrat, March 15 to April 30; fox, November 1 to February 28 (29); bear, August 20 to June 30.

Propagation.—The minister of colonization, mines, and fisheries may grant permits to take animals alive for breeding purposes; nonresidents are charged a fee of from $5 to $25 for such license.

Bounties.—Wolf, $15.

SASKATCHEWAN.

[From Rev. Stat., 1909, as amended to 1917.]

Trapping.—Nonresident requires license (fee, $25) to trap. Unlawful to trap on game refuges; to use poison for taking fur animals; to spear or shoot muskrats, or to destroy muskrat house or beaver dam; to export unprime furs; to buy or sell furs without license (fees, residents north of township 25, $10; south of township 26, $2; nonresidents, $25); and to ship any fur animal in concealed receptacle. Licensed fur traders must make annual report of operations.

Open seasons.—Mink, fisher, and marten, November 1 to March 31; otter and muskrat, November 1 to April 30; fox, north of township 50, November 1 to March 31; beaver, north of Churchill River, November 1 to April 30; no open season for beaver south of Churchill River until December 1, 1920 (1916, ch. 30).

Propagation.—Permit required (fee, $1 annually) to operate a fur ranch. Permit to ship live fur animals is required; fee, for black or silver fox, $25; for cross or red fox, $5; for other fur animal, $5. Young foxes may not be taken from dens before May 15.

Bounties.—Timber wolf, $5 (pup, $1); prairie wolf, or coyote, $1; paid only in properly gazetted wolf districts, when half is refunded from Provincial treasury (1907, ch. 28).

YUKON.

Trapping.—Use of poison in taking animals forbidden.

Open seasons.—Beaver protected at all seasons. No close season for other fur animals, except young foxes; these may not be taken from April 1 to May 31.

Propagation.—No restrictions other than as to foxes. Registration of fox breeders required. Unlawful to export a fox not born in captivity or which has been in captivity for less than a year; any fox born in captivity may be exported under a permit (fee, $5). Fox and other fur ranches, if posted against trespass, may not be approached without owner's consent.

Bounties.—None paid.

LAWS OF NEWFOUNDLAND.

[From game laws of Newfoundland, 1913, corrected to 1917.]

Trapping.—Nonresident trappers require annual license; fee, $501. Fur buyers and shippers also require annual license (fee, 50 cents), and must report operations under same before December 31 of each year. Trapping on Grand Lake Caribou Preserve is unlawful at all times.

Open seasons.—Otter, marten, and lynx, October 1 to March 31; fox, October 15 to March 14; muskrat, October 1 to April 30. No open season for beaver until October 1, 1918.

Propagation.—No restrictions, except as to foxes. A fox farm must be licensed; the owner must at stated times make reports to the game and inland fisheries board, and the premises must be at all times open to inspection by officers of the board. Possession of fox cub or fox taken in close season is prohibited. Unlawful to export a fox not bred on a fox farm, or, without permit from the colonial board, to export a fox bred in captivity.

Bounties.—None paid.

SUMMARY OF FUR PROTECTION.

Beaver.—No open season in 23 States, Alaska, Newfoundland, 6 Canadian Provinces, and parts of 1 other; close season in 9 States, 4 Provinces, and part of 1 Province; may be taken under special license in Michigan, Montana, and New Brunswick; not protected in 16 States and Yukon, the majority of which have no beavers within their borders.

Otter.—No open season in 8 States, Ontario, and part of Manitoba; close season in 19 States and certain counties of 3 others; Alaska, 8 Provinces, part of Manitoba and Newfoundland; not protected in 18 States.

Muskrat.—Close season in Alaska, 24 States, certain counties of 3 States, and all of Canada except Yukon; no close season in 20 States and Yukon; muskrat houses and dens are protected in 14 States and 5 Provinces.

Mink.—Close season in 27 States, Alaska, certain counties of 3 States, and nearly all of Canada; no close season in 18 States and Yukon; bounty in Pennsylvania.

Marten.—No open season in Alaska, New Brunswick, and Nova Scotia; close season in 8 States, 8 Provinces, and Newfoundland.

Fisher.—Close season in 7 States and 9 Provinces.

Skunk.—Close season in 22 States, a few counties of 2 others, and in Nova Scotia and Quebec.

Raccoon.—Close season in 22 States, certain counties of 3 States, and in British Columbia, Nova Scotia, and Quebec.

Opossum.—Close season in 13 States and certain counties of 3 others.

Fox.—Close season in Alaska, 13 States, certain counties of 4 States, and in 5 Provinces and Newfoundland; bounties paid in 4 States and in certain counties of 4 others.

Lynx and wildcat.—Close season in Alaska and Manitoba; not usually protected; bounties paid in 17 States and a few counties of 3 or 4 others. New Brunswick pays bounty on wildcat but not on lynx.

Bear.—Close season in 8 States and (for brown bear) in Alaska; no open season in 5 counties of Oklahoma; open season in British Columbia, dependent on orders in council; bounty on bears paid in 4 States and a few counties elsewhere; special enactments forbidding trapping, or regulating it, exist in several States.

Weasel.—Close season in Alaska and British Columbia; State bounty paid in Pennsylvania and town bounty permitted in Connecticut.

Ferret.—The black-footed native ferret is an exceedingly useful animal, not widely distributed and not legally protected. Domesticated ferrets are used mainly for bolting rats, rabbits, and other animals from dens. A license to keep a ferret is required in Pennsylvania and a permit in Wisconsin. The use of ferrets in hunting rabbits is forbidden by law in Delaware, Illinois, Maine, Maryland, Massachusetts, Michigan, New Jersey, Pennsylvania, Rhode Island, and Wisconsin (except in Door County); forbidden, except on one's own premises, in Indiana, Kentucky, New Hampshire, Ohio, and West Virginia, and in Shenandoah County, Va.; forbidden in New York, except in such counties as have received permission to use them from the conservation commission; also in Vermont, where they may be used to bolt but not to capture rabbits.

Table I affords comparison of the length, in days, of open seasons for trapping the more important fur animals. Alabama, Arizona, the District of Columbia, Massachusetts, Texas, and Yukon have no close seasons. Colorado, Montana, Nevada, New Mexico, and Wyoming have no open season for beavers and no close season for other fur bearers. Idaho and Utah have no open season for beavers and otters; California, none for beavers or sea otters; Washington, no open season for beavers and a close season for bears only; Mississippi has no close season for fur animals except bears, while Georgia has none except for opossums.

TABLE I.—*Length (in days) of open seasons for trapping various fur animals, 1918.*

State or Province.	Beaver.	Otter.	Muskrat.	Mink.	Marten.	Fisher.	Skunk.	Raccoon.	Opossum.	Fox.	Bear.
Alabama	(1)	(1)	(1)	(1)	......	......	(1)	(1)	(1)	(1)	(1)
Alaska	0	136	182	136	0	......	......	......	......	119	......
Arizona	(1)	(1)	(1)	(1)	......	......	(1)	(1)	......	(1)	(1)
Arkansas	0	0	151	151	......	......	151	151	151	151	51
California	0	120	......	120	120	120	120	120	......	120	120
Colorado	0	(1)	(1)	(1)	(1)	......	(1)	(1)	......	(1)	(1)
Connecticut	......	151	(1)	(1)	......	......	181	136	(1)	(1)	......
Delaware	......	0	[2]126	115	......	......	115	138	138	212	......
District of Columbia	......	(1)	(1)	(1)	......	......	(1)	(1)	(1)	(1)	......
Florida	92	92	......	1	......	......	(1)	(1)	(1)	(1)	(1)

[1] No close season.

[2] Except Newcastle County.

TABLE I.—*Length (in days) of open seasons for trapping various fur animals, 1918*—Continued.

State or Province.	Beaver.	Otter.	Muskrat.	Mink.	Marten.	Fisher.	Skunk.	Raccoon.	Opossum.	Fox.	Bear.
Georgia	(1)	(1)	(1)	(1)	......	......	(1)	(1)	151	(1)	(1)
Idaho	0	0	(1)	(1)	(1)	(1)	(1)	(1)	......	(1)	(1)
Illinois	......	151	151	151	......	......	151	151	151	(1)	......
Indiana	74	74	151	151	......	......	74	74	74	74	......
Iowa	121	121	121	121	......	......	(1)	(1)	(1)	(1)	......
Kansas	0	0	121	121	......	......	121	121	121	(1)	......
Kentucky	47	47	(1)	47	......	......	47	47	47	(1)	......
Louisiana	0	107	107	107	......	......	107	107	107	107	107
Maine	0	137	[2] 198	137	137	137	137	......	......	137	(1)
Maryland [3]	......	......	......	......	......	......	......	......	......	......	......
Massachusetts	......	(1)	(1)	(1)	......	......	(1)	(1)	......	(1)	......
Michigan	[4] 195	119	119	119	119	119	119	119	......	(1)	......
Minnesota	0	0	136	136	(1)	(1)	(1)	(1)	......	(1)	138
Mississippi	(1)	(1)	(1)	(1)	......	......	(1)	(1)	(1)	(1)	120
Missouri	63	63	63	63	......	......	63	63	63	63	......
Montana	[4] 0	(1)	(1)	(1)	(1)	(1)	(1)	(1)	......	(1)	(1)
Nebraska	0	107	107	107	......	......	......	107	107	......	......
Nevada	0	(1)	(1)	(1)	......	......	(1)	(1)	......	(1)	(1)
New Hampshire	0	120	120	120	120	120	120	120	......	120	......
New Jersey	0	138	138	138	......	......	138	76	(1)	(1)	......
New Mexico	0	(1)	(1)	(1)	......	......	(1)	(1)	......	(1)	(1)
New York	0	(1)	162	126	126	(1)	93	126	(1)	(1)	(1)
North Carolina [3]	......	......	......	......	......	......	......	......	......	......	......
North Dakota	60	60	150	150	......	......	(1)	(1)	......	(1)	......
Ohio	......	(1)	79	79	......	......	79	......	79	100	......
Oklahoma	0	0	121	121	......	......	121	121	121	121	......
Oregon	[2] 0	120	120	120	120	120	(1)	(1)	......	(1)	(1)
Pennsylvania	0	(1)	(1)	(1)	(1)	(1)	(1)	122	(1)	(1)	62
Rhode Island	......	(1)	165	165	......	......	165	165	......	(1)	......
South Carolina [3]	......	......	......	......	......	......	......	......	......	......	......
South Dakota	121	121	121	121	......	......	(1)	(1)	......	(1)	......
Tennessee [2]	92	92	92	92	......	......	92	92	92	92	......
Texas	(1)	(1)	(1)	(1)	......	......	(1)	(1)	(1)	(1)	......
Utah	0	0	(1)	(1)	......	......	(1)	(1)	......	(1)	(1)
Vermont	0	181	[2] 181	181	163	163	163	163	......	164	(1)
Virginia [3]	......	......	......	......	......	......	......	......	......	......	......
Washington	0	(1)	(1)	(1)	(1)	(1)	(1)	(1)	......	(1)	242
West Virginia	......	(1)	(1)	61	(1)	......	61	61	(1)	61	......
Wisconsin	[2] 0	0	[5] 178	79	79	79	79	79	......	(1)	21
Wyoming	0	(1)	(1)	(1)	(1)	(1)	(1)	(1)	......	(1)	......
Alberta	0	181	181	151	151	151	(1)	......	......	......	......
British Columbia	181	181	181	181	181	181	(1)	181	......	136	......
Manitoba—Northern	181	181	117	151	151	151	(1)	......	......	120	......
Southern	0	0	75	151	151	151	(1)	......	......	(1)	......
New Brunswick	[4] 0	151	51	151	0	151	(1)	(1)	......	151	......
Northwest Territories	226	226	226	195	195	195	......	......	......	(1)	(1)
Nova Scotia	0	92	92	92	0	92	92	92	......	92	......
Ontario—Northern	0	0	50	181	181	181	(1)	(1)	......	(1)	(1)
Southern	0	0	51	181	181	181	(1)	(1)	......	(1)	......
Prince Edward Island	0	151	151	151	151	......	......	......	......	(1)	......
Quebec	151	151	47	151	151	151	151	151	......	151	314
Saskatchewan	181	181	181	151	151	151	......	......	......	(2) (1)	(1)
Yukon	(1)	(1)	(1)	(1)	(1)	(1)	......	......	......	(1)	(1)
Newfoundland	0	182	212	......	182	......	......	(1)	......	151	......

[1] No close season.
[2] Local exceptions.
[3] Local county laws.
[4] Under special license only.
[5] In 18 counties, 188 days.

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FARMERS' BULLETIN 1023
United States Department of Agriculture

Machinery for cutting firewood

POWER MACHINERY for cutting firewood offers a practical solution of the fuel problem on farms where wood is available. A day's work with a buzz saw or a drag saw will yield as much firewood as could be cut in many days' hard work by hand and will effect a saving of labor, or coal, or perhaps of both, that is well worth considering at a time when both are scarce and high priced.

The shortage of coal in many localities has been due as much to shortage of cars to haul it as to scarcity of coal. The more wood is burned the less coal will need to be transported and the more cars will be released for other needed service. He who burns wood instead of coal helps in the general transportation situation.

This bulletin describes the different types of wood-sawing rigs, points out the advantages and disadvantages of each, gives information as to first cost and cost of operation, and offers suggestions as to how they may be operated most efficiently.

OFFICE OF THE SECRETARY
Contribution from the Office of Farm Management
E. H. THOMSON, Acting Chief
Washington, D. C. January, 1919

MACHINERY FOR CUTTING FIREWOOD.

H. R. TOLLEY, *Scientific Assistant.*

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WOOD FOR FUEL.

THE LARGE AMOUNT OF LABOR required in preparing firewood for the stove heretofore has kept many farmers from using wood for fuel, even though there was plenty of wood on the farm which would be almost if not entirely wasted if not used for this purpose. (See fig. 1.) Now, when the National coal supply is low and prices high, farmers who can supply their fuel from their own farms will find it considerably more profitable than in normal times. A still greater consideration is that it is also a patriotic thing to do.

FIG. 1.—In many cases enough fallen timber will be found in the farm woodlot to supply the family with fuel for several seasons.

The use of power machinery will reduce the labor requirements to the point where the farmer should be able to get his wood ready to burn without seriously neglecting other work. (See fig. 2.) A great

NOTE.—Thanks are due to Mr. E. R. Hodson, of the Forest Service, U. S. Department of Agriculture, for suggestions followed in the preparation of this bulletin.

many farmers already have gasoline engines suitable for furnishing the power for wood-sawing machines. These machines are comparatively inexpensive, and the labor one saves will be sufficient to pay for it long before it is worn out. One outfit can do the work for several families each year, and the purchase of a complete outfit, including an engine to furnish power, may be profitable for a group of farmers or for one who has an opportunity to do custom work for his neighbors.

GETTING WOOD READY FOR THE SAW.

When cutting into stove lengths is done with a power-driven saw, cutting down the trees and trimming them ready for the saw takes more time and is harder work than anything else connected with the preparation of firewood. If trees selected for fuel contain any marketable timber, it will usually be advisable to save it and use only the tops and inferior part of the trunks for firewood. The work of preparing a given amount for fuel will be considerably greater in cases like this than if the entire trees are used.

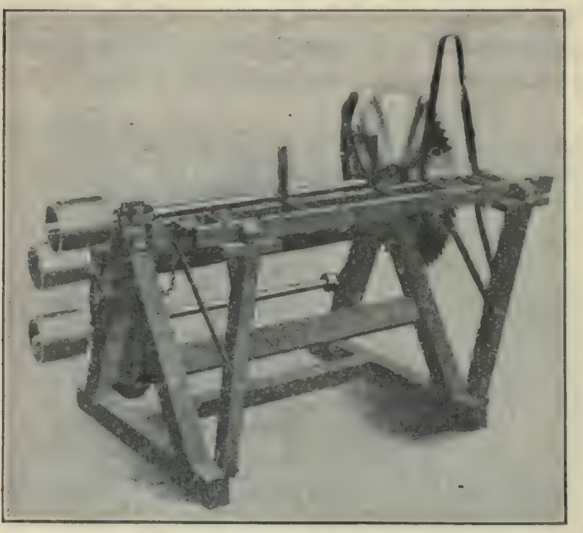

FIG. 2.—A tilting-table wood-sawing machine with the flywheel placed below the table. Such an outfit will handle either cordwood or light poles with equal facility.

If the work is being done on the farm by the regular farm help, it will usually be best to cut the wood into lengths as long as two or three men can handle without loss of time in loading and hauling out of the woods and in getting to the saw. It takes much less time to cut through a log with a power-driven saw than it does by hand, and the longer the logs are cut the less is the total amount of time and labor required to get the wood ready to burn—provided, of course, they are not too heavy to handle without serious loss of time. If a good skidway is built so that the logs and heavy poles can be rolled up on to the table of the buzz saw, or the carrier of the drag saw, as the case may be, longer and heavier pieces can be handled more efficiently than if all must be lifted directly off the ground to the saw.

Where it is possible it will be worth while to set the saw on a slope, so that the logs and poles can be skidded into a pile above it. They can then be rolled to the saw with little effort, and the skids for raising them to the table or carrier of the saw can be approximately horizontal. An arrangement like this might make possible the operation of the sawing outfit with one less man than would be required if the saw were placed on level ground. When the wood can not be dragged or skidded to the saw, the work of loading it will be somewhat less if it is hauled on sleds than if wagons are used.

The wood will be free from dirt and grit when it goes to the saw if it is cut and hauled out over the snow, and the saw blade will not need filing so often and will last somewhat longer if all the wood which it saws is free from dirt and sand. However, if the wood cutting is left until midwinter in the northern part of the country, the snow may become so deep that it will be very difficult to get into the woods at all with a team.

In many localities it is customary, before hauling the wood to the saw, to cut it all into 4-foot lengths and to split any large logs into sticks that can be handled easily by one man. The total amount of work required for getting the wood into stove lengths and sizes will be somewhat greater when this method is followed than when it is left in large logs and long poles, but under some conditions it will probably be more satisfactory. Where the wood is being cut by extra labor, cutting it into 4-foot lengths and cording it up in piles 4 feet high makes it easy to measure accurately for sale and purchase or when the woodcutters are working on a piecework basis. If the wood is to be hauled a long distance before it is cut into stove lengths, it may be better to have it cut into cordwood—as wood in this shape is usually called—in the woods. A greater quantity can be put on a wagon than of logs and poles of irregular lengths. One man can load and unload the cordwood easily, while it would take two or more if it were left in pole lengths. Also, a smaller saw can be used efficiently for cutting the cordwood into stove lengths.

However, if the wood is all on the farm, if it can be taken to the saw at odd times, if the haul is short, and if enough help is available to handle the big logs and long poles, the practice first described is probably the more efficient. The fewer times the logs and poles are cut by hand the less will be the total amount of labor expended on the wood.

When the entire tree is to be used for firewood and the trunk cut into lengths sufficiently short for two men to handle in loading and sawing, and the tops cut into poles and sticks as long as possible, it probably will be a fair day's work for two men to prepare for the saw a supply sufficient to make from four to six cords. If the best parts of the trees are saved out for timber and only the tops and unsound parts used for firewood, the labor necessary to get out a given amount will, of course, be considerably greater. If all is made into cordwood and then corded up into orderly piles, the amount of work necessary will be nearly doubled. However, it will not take quite as long to haul the cordwood to the saw and most certainly will not take as long to saw it.

THE CIRCULAR SAW.

Buzz-saw outfits for cutting firewood are built in a variety of sizes and styles. The size and style best suited to a particular place will depend mostly on the character and amount of wood to be cut, the power available for running it, and the number of men to be used on the work. The saw blades are made in sizes from 12 inches or less up to 36 inches in diameter and the frames are of corresponding size and strength. Some of the smaller frames are not provided with flywheels, some have the flywheel mounted directly on the saw mandrel, and some have it mounted on a separate shaft below the saw table. The tables for holding the wood as it is pushed against the saw blades are of two general types, the tilting or swinging table and the rolling or sliding table.

SIZE AND SPEED OF SAW BLADE.

The saw blade provided should be of ample size to cut through at one operation the largest pieces of wood commonly handled. The diameter of the largest stick that can be cut depends somewhat on the way the table is mounted with reference to the saw blade, but it will always be a little less than half the diameter of the blade. Blades of from 24 to 30 inches in diameter are the most popular sizes. A 24-inch blade will cut a stick as much as 9 inches in diameter satisfactorily, and a 30-inch blade should handle logs up to approximately 1 foot thick. Wood so large that the saw will not reach clear through it can be cut by turning the pole or log and cutting through it again, but this will result in a considerable loss of time, for it takes at least twice as long to cut the log in two this way as would be required if the saw were large enough to cut it through at once.

It may be well when purchasing a new saw blade to get one somewhat larger than actually required, for it will keep getting smaller as it is used and the teeth worn and filed away. Aside from the difference in first cost, the large saw blade can be run just as economically as the small one, and it will be possible to use it at any time for wood larger than ordinary without loss of time. This point should be borne in mind, especially by the man who expects to do any large amount of custom work or cutting of wood for sale.

The speed at which the saw blade is run is another important factor. The best speed will vary somewhat for different kinds of wood, but manufacturers and experienced saw users are of the opinion that variation of more than a few per cent from the standard speed is never desirable. The peripheral speed (the rate at which the saw teeth travel) recommended is between 9,000 and 10,000 feet per minute, which makes about 1,200 revolutions per minute for a 30-inch blade and about 1,500 for a 24-inch blade, with correspondingly smaller or larger number of revolutions per minute for saws of other sizes. The operator should know the speed at which his engine runs and should be sure that the pulley on the saw is of the right size to give the proper speed. Too low speed will make quick, clean cutting impossible and too high speed will require excessive power and at the same time cause needless wear and tear on the saw and frame.

THE SAW TABLE.

Original cost and personal inclination of the operator will probably have something to do with the kind and size of table selected for the sawing outfit, but, generally speaking, the small tilting table is preferable for cutting cordwood or small short pieces and the rolling table for wood of large diameter. The tilting table is usually pivoted to the lower part of the frame and so built that when a cut is finished gravity will pull the table from the saw and into position for moving the wood up for the next cut.

These tilting-table saws are often designed only for cutting cordwood. In such cases the table is built directly in front of the saw mandrel, and the uncut part of the stick goes up between the flywheel and the saw blade. The piece that is cut off then can fall directly to the ground and be out of the way for the next cut. The saw mandrel will usually be less than 4 feet in length; and if the flywheel is mounted on the saw mandrel, poles or other longer pieces of wood can not be put on the table without coming into contact with the flywheel. Tilting-table frames built for cutting pole wood either have the flywheel mounted on another shaft so that it runs below the table (see fig. 2), or have the table placed on the side of the saw blade away from the mandrel, so that the wood is fed to the saw from the outside (see fig. 3).

For the larger poles and logs the rolling or sliding table is usually preferred. (See fig. 4.) A table of this kind will carry the heavy pieces into the saw more evenly than the tilting table and with probably less effort on the part of the men. The rolling table will not come back into position for a new cut as quickly and easily as the tilting table, but the loss of time will not be relatively so great on large logs as on smaller pieces, and the greater ease in handling long heavy pieces will usually more than offset this slight loss in time.

The table should be long enough to carry the longest logs and poles without much effort being expended by the sawyer or his helper. It will be easier to push these heavy pieces forward on the table if it is provided with a roller at the end. The longest tables sometimes have more than one roller. If the table is not equipped with rollers and the logs are hard to push forward, some pieces of gas pipe one or two inches in diameter and a foot or so long placed under the logs as they come on the table will make the work much easier.

Rolling or sliding table saw frames are nearly all so built that the wood is brought up to the saw on the side opposite the flywheel, and the short piece cut off is left on the table between the blade and flywheel. This must be removed before the log can be advanced for the next cut, and if the man who is doing this work falls behind, time will be lost by the remainder of the crew.

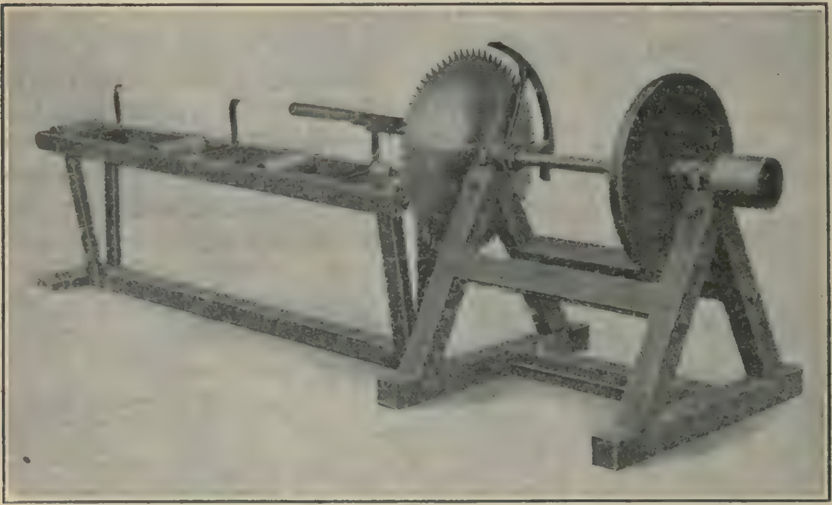

FIG. 3.—A tilting-table saw frame with the table on the side of the blade opposite the flywheel, designed primarily for cutting heavy poles and logs.

DANGER TO OPERATOR.

There is an element of danger which should always be borne in mind when using a circular-saw machine. The saw runs at high speed, and an instant's contact with the blade is sufficient to sever a finger or even the whole hand. Such accidents are not infrequent, but they are nearly always due to the carelessness of the sawyer. Every saw table should have a guard to prevent the hand or arm coming in contact with the blade while moving the wood on the table. Many saws have a guard over the back and upper part of the blade as an additional safety device, but even the best of these will not prevent all the accidents due to carelessness. The careful sawyer will not only have these guards on his saw, but will have the danger connected with the work constantly in mind.

A piece of wood that comes in contact with the saw teeth at any time except when it is on the table in the proper position for cutting will likely be thrown from the saw with sufficient force seriously to injure a man. Saw blades have been known to burst on account of flaws or cracks or being run at too high speed. Anyone in the path of the flying pieces surely will suffer serious injury.

POWER AND FUEL REQUIREMENTS.

A circular-saw outfit can be operated with a wide range of power, and a large majority of the gasoline engines found on farms may be used for this purpose. The actual power required depends on the size and kind of the wood to be sawed, the rate at which it is fed to the saw, and to a certain extent on the condition of the saw blade. If a small engine is used it may be necessary to feed the saw slowly and split up some of the larger pieces before they come to the saw. If much of the wood to be cut is thick and heavy, a somewhat larger engine should be provided than where cordwood that has all been split into small pieces or top wood of only a few inches diameter is to be cut exclusively.

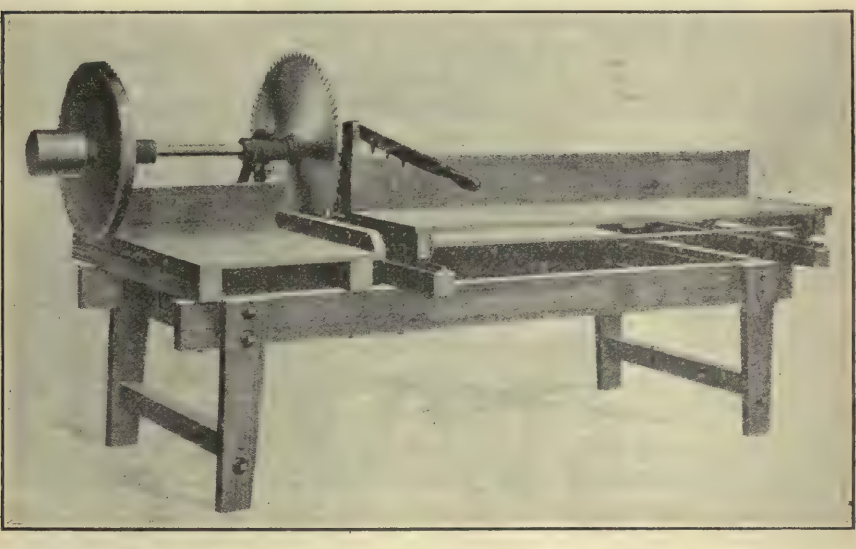

FIG. 4.—A rolling-table saw frame of the type suitable for cutting all kinds of wood from the heaviest logs to light poles. Such a machine is usually preferred when the entire trees are used for firewood and are brought to the saw in as large pieces as can be handled.

Practically all manufacturers recommend not less than a 4-horsepower engine for their saws, and for heavy wood a little larger one of, say, 6 horsepower may be preferable. An engine of this size, when in good order, should be able to cut the largest wood as fast as it can be brought to the saw. A still larger engine can be used, although the fuel cost usually will be somewhat greater. However, if the governor is adjusted correctly the load will determine to a certain extent the fuel consumption.

Some farmers use for cutting their wood engines up to 12 or 15 horsepower, which have been installed primarily for heavier work, such as cutting ensilage, running a large feed grinder or a small thrashing machine, and consider the practice more economical than the purchase of an engine especially for the wood saw. Even the tractor is sometimes used, and it is probably a good practice if there is no other engine on the farm, and only the family supply of wood is to be cut.

Some small rigs are designed especially for use with engines of only 3 or even 2 horsepower. They do not cost as much as the heavier machines and should do satisfactory work on small wood when only one or two men are used. Even the outfits which are designed primarily for more power can be used with engines of this size. With no more power than this the saw will have to be fed slowly and the time required for cutting a given amount of wood will be considerably greater than when more power is used. If only the family supply of wood is to be cut, and that done by the regular farm help at times when other work is not pressing, a reduction of even 50 per cent in the output of the saw would scarcely be enough to warrant the hire or purchase of a heavier engine, provided the one on hand were suited to the other work on the farm. The work would still be much easier and take much less time than if it were done by hand.

The man who expects to do much custom work or cut much wood for sale will usually find it profitable to provide himself with an engine just large enough to run the saw at the proper speed under the maximum load. If it is necessary to favor the engine to any great extent the loss of time on the part of three or four men who are being paid good wages will soon become a serious matter. On the other hand, there would be no advantage in providing an engine larger than necessary.

The standard fuel consumption of a gasoline engine is from a sixth to an eighth of a gallon per horsepower per hour when working under full load; that is, a pint or a little over. This would make approximately 8 gallons of gasoline necessary for a 6-horsepower engine, running 10 hours under full load. However, experienced saw users estimate the average fuel consumption in sawing wood with engines of approximately this size as not over 5 gallons per 10-hour day. This difference is probably due to the fact that the engine does not run under full load all the time, and the amount of gasoline used is automatically reduced when the engine is running without load or under a light load.

PORTABLE OUTFITS.

Sawing outfits with the engine and the saw mounted on the same truck are manufactured by several firms, and are in favor with men who do custom work or for other reasons often desire to transport the rig from place to place. (See illustration on title-page.) They are built in a variety of styles and sizes and with engines of different sizes, so that one can be found that is suitable for almost any kind of wood cutting. One team can easily draw the whole rig. However, for the individual who cuts only his own wood, or where wood cutting constitutes only a small part of the work which the engine will do, it will usually be preferable to have the engine and saw as two separate units. While it is possible to use the engine on a combined rig for other work, the saw blade and frame will always be more or less in the way and to remove them is too much trouble.

SIZE OF CREW AND RATE OF DOING WORK.

The number of men required for the most efficient operation of a buzz saw, and the amount of wood which they can cut in a given time will depend on the wood, the machine, the power available, and the skill of the men. When the whole trees are being converted into firewood with a saw large enough to cut the largest pieces without loss of time and an engine powerful enough to drive the saw at the proper speed under the heaviest load, at least four men will be required to keep the wood up to the saw as fast as the saw will handle it. With a four-man crew, one man will do the actual sawing, one will help hold the logs and poles on the table and push them forward into position for the successive cuts, one will remove the blocks from the saw as they are cut, and the fourth will keep the logs and poles up to the saw.

A fifth man often can be used to advantage to help get the logs up to the saw and to split or slab some of the larger blocks after they have been sawed. If the saw is placed on a slope below the logs and a skidway and possibly a stationary table built beyond the end of the sawing table, it may be possible to dispense with one man who otherwise would be necessary for helping get heavy logs up to the saw.

The rate at which wood is cut with a good-sized outfit depends almost entirely on the speed with which the wood is brought up to the saw, and the skill of the sawyer and his helper in pushing the logs and poles forward into position without unnecessary loss of time. Under average conditions such an outfit as this should cut in the neighborhood of 20 cords into stove lengths of 12 to 16 inches in a 10-hour day, if kept working steadily. With a crew that works together well, and a saw and engine that are in first-class condition. the output can easily be made greater than this.

In cutting cordwood into stove lengths a smaller crew should be able to keep the saw busy. If the wood is piled near the saw, one man ordinarily can keep the saw supplied, and the man who is doing the sawing will not need a helper. Thus three men usually will be a full crew, one to get the wood to the saw, one at the saw, and one to clear it away and pile it up. Having the wood cut into 4-foot lengths and the larger pieces split into sizes that one man can handle saves at least one man's time at the saw. However, as before stated, this saving in itself is not sufficient to warrant having the wood put in this shape before sawing.

In cutting poles or cordwood the saw can be operated with fewer men than this. Two men can operate the outfit in cutting heavy wood and still make much better time than when cutting by hand, and if a man is cutting wood for himself alone, and has only one man to help him, it may be more economical to do it with the two men than to hire extra hands. The saw will have to be idle while the logs and poles are being brought up to the table and while the cut blocks are being removed, but two men can probably do half as much as the full crew of four. The two men should be able to cut the whole year's supply of wood for the farm in two or three days, and if they can do this without neglecting other work, it may be more economical than hiring extra men. Similarly, two men, or even one, can operate the saw in cutting cordwood into stove lengths. However, if a full crew can be got together by exchanging labor with neighbors, the work can be done more quickly and easily and with less cost for fuel for the engine.

THE DRAG-SAW.

The drag-saw for cutting firewood is not in as common use as the circular saw, but many men use it and for cutting large logs find it preferable to the circular saw. It is most efficient in cutting larger logs and can scarcely compete with the circular saw on wood less than 10 or 12 inches in diameter. A drag-saw is a somewhat more complicated machine than a circular saw, costs from two to three times as much, and does not cut as fast as a circular saw. Its operation is simple, however. It does not require a great deal of power, and while it will not saw through a log or pole as quickly as a buzz saw, the manual labor connected with its use is considerably less for the same class of work, and it can be operated efficiently with a smaller crew.

The carrier of the drag-saw can rest directly on the ground, and the work of rolling the logs on to it is not so great as that required for getting them on to the table of a circular-saw machine. After the log is on the carrier it is not usually necessary to use any more hand labor in connection with the sawing. Most of the drag-saws have power feeding devices, and by simply pushing a lever the carriage with the log on it moves up into position for the successive cuts. When a gas engine is used the saw operator has nothing to do but manipulate the levers and raise and lower the saw. Three men, including the saw operator, make a full crew, and they will usually be able to split the blocks into stove-wood size in addition to keeping the uncut logs up to the saw. One man can run a drag-saw by himself and cut a goodly amount of wood in a day. He will have to stop the saw while he is getting the logs on to the carriage and clearing away the cut blocks. If the logs are large it will be hard work, but if only the one man is available he can do several times as much with a drag-saw as he could do by hand.

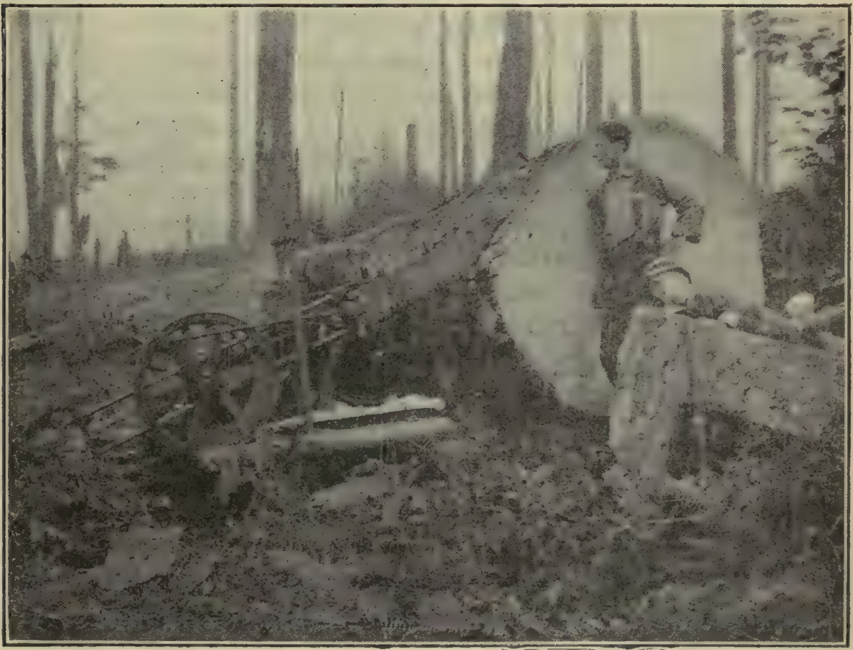

FIG. 5.—A one-man drag saw outfit, cutting into firewood a log which it would be impossible to handle with any other kind of power machinery.

Portable drag-saw outfits are designed especially to enable one man to cut logs which are too heavy for him to roll and skid. The engine and saw are mounted on the same frame. The log remains stationary on the ground and the sawing outfit is moved along to the places for the successive cuts. (See fig. 5.) Work with a saw of this kind is slower than with one where the logs are placed on a movable carriage, but it enables one man to work alone, whereas several men would be required if the saw were stationary and the logs had to be moved.

Even when running the ordinary drag-saw with a full crew, it will not be possible ordinarily to cut wood as fast as with a circular saw. The actual cutting is not done so fast and the time taken to move the log up into position for a new cut will usually be somewhat greater than with the circular saw. However, the work is much easier, and two or three men can do at least as much in cutting heavy logs a foot or more in diameter with a drag-saw as they can with a circular saw.

Before the advent of the gasoline engine many farmers cut their wood with a drag-saw driven by horsepower, and this method is still used to some extent. One horse in a treadmill or on a sweep can run the saw if given occasional rests. When only one man is working, the stops due to getting the logs up to the carriage and clearing away the cut blocks will usually give the horse sufficient rest.

For a man who cuts a large amount of wood that is not put into cordwood shape by hand, a drag-saw for the larger logs and a circular saw for the tops and smaller poles make a very efficient combination. The same engine can be used for both saws, a smaller crew can be used than with the buzz saw alone, and not so much hand work in getting the wood ready for the saw will be necessary. The logs to be cut with the drag-saw do not have to be lifted off the ground and handled as much as if they were to be cut with a circular saw, and consequently can be left in longer lengths in preparing them for sawing. Not more than three men should be necessary for the drag-saw when cutting the largest and longest logs, and the same crew can handle easily the smaller poles and tops that are cut with the circular saw.

COST OF OPERATING.

At present prices the first cost of a fully equipped circular sawing machine, including saw blade, is from $25 to over $50, depending upon the size of the saw blade, the construction of the table, frame, etc. The drag-saw is a more complicated machine, and one fully equipped with power feed and blade costs at least $100.

The number of years' service which either of these machines will give will be determined by the care which it receives and the amount of work it does. Ordinarily it will be used a relatively small number of days each year, and since it is a comparatively simple machine the life, aside from the saw blade, will depend largely on the care which is given it. The estimates of about 25 experienced operators show the average life of either a circular- or drag-saw machine is from 15 to 20 years when used for sawing the family supply of wood each year, and possibly loaned to a neighbor or used on a small amount of custom work.

The average amount sawed by these machines was about 30 cords annually, with a range of from about 10 to over 100. The saw blade itself is subject to greater wear than the other parts of the machine, and unless it receives the best of care it can not be expected to last so long.

The cost of upkeep and repairs, aside from the blade, should be very low. In fact most men say they are at no expense for repairs to the saw frame and table, as they make any needed repairs themselves at odd times. The saw blade will need filing and setting often, but the operator should be able to do that himself. It will need gumming occasionally, and unless he has had some experience in this work and has the proper tools, it will usually pay to have this done at the factory or machine shop. The cost will depend on the size and condition of the saw, but should rarely be over $2. An average of $1 per year will usually cover the outlay for upkeep and repairs both to the saw frame and the blade.

For a sawing machine with an initial cost of $50, lasting 15 years and sawing 30 cords per year, and having $1 per year spent on it for upkeep and repairs, the charge against each cord for depreciation, interest, and repairs, would be approximately as follows:

Annual depreciation one-fifteenth of $50	$3.33
Interest (6 per cent on average value, $25)	1.50
Repairs	1.00
Total annual cost	5.83
Cost per cord	.19

On the basis of 5 gallons of gasoline for running the engine for 10 hours and cutting 20 cords in that time, about a quart of fuel per cord is required. This will necessarily vary, however, with the size of the engine used and the rate at which the wood is cut. With a very efficient engine and the crew working steadily, it might be reduced 50 per cent, easily, and with a large engine and a crew that could not keep the saw fully supplied with wood, the fuel consumption might easily increase 100 per cent. At present prices (1918) the cost of a quart of gasoline is about 6 cents. This makes the total cost exclusive of the engine approximately 25 cents per cord.

If the engine is already on the farm and is used principally for other work, the farmer may prefer to ignore any engine charge for cutting wood. If, on the other hand, the engine is used only for cutting wood and the entire cost is charged against this operation, a large amount will have to be cut each year to make the investment profitable. At present an engine for this work costs from $200 to $500. With a cost of $300, and a life of 15 years, the annual charge for depreciation on the engine will be $20, and for interest (6 per cent of $150) about $9, making $29 per year, or approximately $1 per cord for these two items alone, if the engine is used only for cutting 30 cords of woods annually. Thus it will not be profitable for a farmer to purchase an engine for use only in cutting his own wood.

However, if several farmers can combine in the purchase and use of a complete wood-sawing outfit, including the engine, the original cost to each one will not be so great and the cost per cord cut will be reduced to the point where the outfit will pay for itself in a few years at the most. With a sawing outfit, as with other farm implements, the more work it does the less will be the machinery cost to be charged against each cord cut. A further advantage of cooperation in the ownership of an outfit is that the owners usually find it possible to cooperate in the actual work of cutting the wood, and by exchanging work succeed in getting all the wood cut with little or no cash outlay for hired help.

Where the cooperative plan is not feasible, many farmers prefer to have their wood cut with a hired outfit rather than to purchase an individual rig. The machines are sometimes hired by the day or hour and sometimes by the cord. In cutting poles or heavy wood that has not been put into cordwood, the outfit is usually hired on a time basis. When the saw owner furnishes the fuel for the engine and his own time, $1 or less per hour is usually charged in the eastern part of the country. If the saw is kept busy wood can be cut at the rate of at least two cords per hour. Thus the use of a hired machine for cutting wood will cost the farmer less than 50 cents per cord. In cutting cordwood the outfit is often hired at a fixed rate per cord. Where the saw owner furnishes the fuel and only his own time, the price is usually 35 to 50 cents per cord. If a custom rig has a great deal of sawing to do every year the charges for depreciation, interest, and probable repairs will be considerably less per cord than on the individual outfit. Consequently, the custom outfit can do the work at a price equal to or below the cost of doing it with an individual outfit and still return a profit to the owner.

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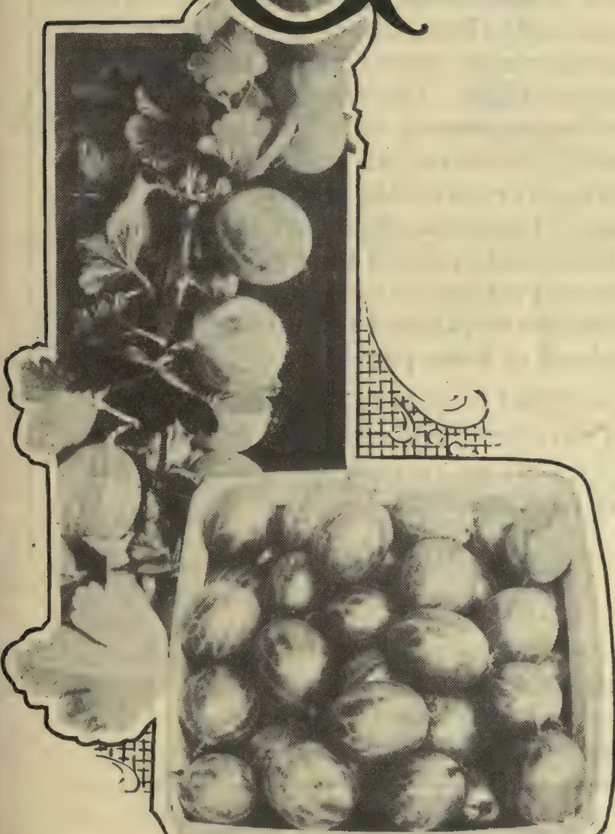
United States Department of Agriculture

Currants and Gooseberries



THIS BULLETIN gives information with regard to the essential features of currant and gooseberry culture, indicates the regions in which these plants may be grown, and points out certain restrictions on their culture due to insect pests and diseases.

In localities where it has become established the currant maggot, an insect for which there is no satisfactory method of control, practically prohibits the successful growing of both these fruits.

Blister rust, a disease that is very destructive to white-pine trees and which passes one stage of its growth on currants and gooseberries, is a serious menace in some sections. In order to protect these trees wherever they represent valuable lumber interests it is necessary to destroy all currant and gooseberry bushes in such areas and to prohibit the further planting of them. The laws which have been enacted by several States to this end and the Federal quarantine regulations respecting the interstate shipment of currant and gooseberry plants and pine-tree nursery stock are explained in these pages.

The reader will find helpful suggestions regarding the selection of varieties of currants and gooseberries for planting, as well as recipes for making some widely popular fruit products.

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief
Washington, D. C. April, 1919

CURRANTS AND GOOSEBERRIES.

GEORGE M. DARROW,
Scientific Assistant, Office of Horticultural and Pomological Investigations.
With contributions by others.

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REGIONS WHERE CURRANTS AND GOOSEBERRIES CAN BE GROWN.

BOTH CURRANTS AND GOOSEBERRIES are natives of cool, moist northern climates and in the United States succeed best in the northern half of the country and east of the one hundredth meridian. They are injured by the long hot summers of the Southern States, except in the higher altitudes of the Appalachian Mountains. Even in Missouri and Kansas they do not succeed very well. They are not adapted to the hot interior valleys of California, but are grown in the northern coast counties of that State. Figure 1 shows the approximate southern boundary of the commercial culture of these fruits.

Gooseberries are grown slightly farther south than currants and seem to endure the summer heat somewhat better. More spraying, however, is necessary to keep the foliage of currants and gooseberries in a healthy condition in the southern part of their range than in the northern part.

Currants and gooseberries are very hardy and withstand extremely low temperatures; in fact, if windbreaks are provided, most varieties are able to withstand the severe conditions in most parts of the upper Mississippi Valley and the northern Great Plains area.

In the region west of the one hundredth meridian limited rainfall restricts their culture materially, except in irrigated sections and in comparatively small areas in northern California, the Willamette

Valley, and the Puget Sound region. The approximate boundaries of these areas are shown in figure 1.

Four factors limit the growing of currants and gooseberries in the United States: The white-pine blister rust, the currant maggot, the lack of moisture, and the heat of summer.

The blister rust makes it necessary to eradicate currant and gooseberry plants already growing and to prevent new plantings wherever the white pine is an important forest tree and there is danger of that disease being spread to valuable forest areas (see p. 22). The map shown as figure 1 outlines the areas where these plants may be grown.

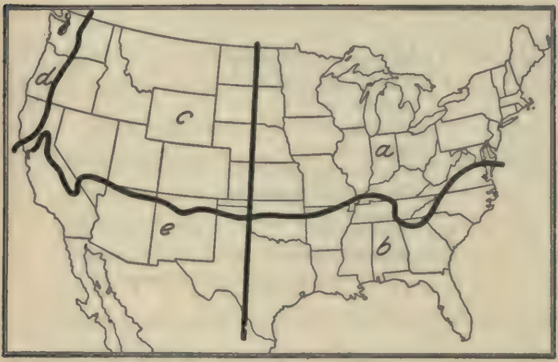

FIG. 1.—Map of the United States, showing the regions where currants and gooseberries may be grown. The area marked *a* is naturally best adapted to currants and gooseberries; in *b* the summers are too long and too hot for these fruits; in *c* low rainfall limits their culture except under irrigation, though these fruits are planted in many dry-land fruit gardens throughout this region. Although the area marked *d* has sufficient rainfall for these fruits, most of the rain occurs during the winter months and the moisture must be carefully conserved, while *e* is both too dry and too hot in summer. The boundaries of these areas are not sharply defined, but grade imperceptibly into each other.

The fruit worms, especially the currant maggot, are very serious pests on currants and gooseberries in the Mountain and Pacific Coast States and have made the production of these fruits difficult in many sections there. The currant maggot, for which there is no known means of control, occurs also in some localities in the Eastern States. Some very productive and profitable plantations may be found in the area designated as *c* in figure 1, and small plantings are scattered throughout the whole area, but until local conditions have been investigated currants and gooseberries should not be planted commercially in that part of the country.

SOIL AND SITE FOR A PLANTATION.

The soil selected for the currant and the gooseberry should be cool, well drained, and fertile. The heavy types, such as silt or clay loams, are usually better in these respects than sandy soils. Neither fruit will do well on land where water stands during any part of the year.

In regions toward the southern limit of their culture it is best to select a northern or northeastern slope, in order to give some protection from the sun. The north side of a building may be selected when only a few plants are to be grown for home use.

A place with good air drainage is preferred for gooseberries. In low, damp places mildew attacks both fruit and foliage more severely than on higher sites where the air circulation is better. Currants, however, are seldom severely attacked by mildew. Therefore, when the site is a sloping one, currants may be planted on the lower parts and gooseberries above. As both fruits blossom very early in the spring, neither should be planted in low pockets where late spring frosts may kill the flowers.

PREPARATION OF THE SOIL.

Before planting, the soil should be prepared as for garden crops. This includes deep plowing and thorough harrowing. Recently plowed sod land should not be used as a rule, because the sod will interfere with the setting of the plants and the management of the plantation until it becomes completely rotted. Sod land plowed early in the autumn and replowed and harrowed the following spring will usually be in good condition for planting, as will land in a good state of fertility following a crop of potatoes, tomatoes, or some other hoed crop.

PROPAGATION OF THE PLANTS.

Plants of the varieties desired generally can be secured from reliable nurserymen at small cost, and this is a satisfactory way to obtain them either for the home fruit garden or for commercial plantings. They may be propagated in the home garden, however, by means of layers or cuttings.

Gooseberries ordinarily are propagated by mound layers. The plant from which layers are to be procured should be cut back heavily before it begins to grow in the spring. By July it will have sent out numerous vigorous shoots. It should then be mounded with earth half way to the tips of the shoots, as shown in figure 2. By autumn the shoots will have rooted. Those with strong roots may then be cut off and set in the nursery, to be grown for one or two years before planting in the field. If the roots are not well developed, it will be better to leave the shoots attached to the parent plant for a second year. They will make strong root systems meanwhile, and then, if grown for a year in the nursery, after being cut from the parent plant they will be satisfactory for planting. The latter method is more common in the case of European varieties, which do not root so readily as American sorts.

A few varieties of gooseberries are propagated more easily by cuttings than by layers. Those varieties which are of European parentage are generally the most difficult to propagate by cuttings. American sorts vary greatly in this respect, however. Thus, cuttings of the Houghton variety root readily, while those of the Downing do not. Two new and as yet little-known varieties, the Poorman and the Van Fleet, are easily propagated by cuttings. If cuttings are used, they should be of the current season's growth and about 8 inches long, and they should be handled in accordance with the directions given below for currant cuttings.

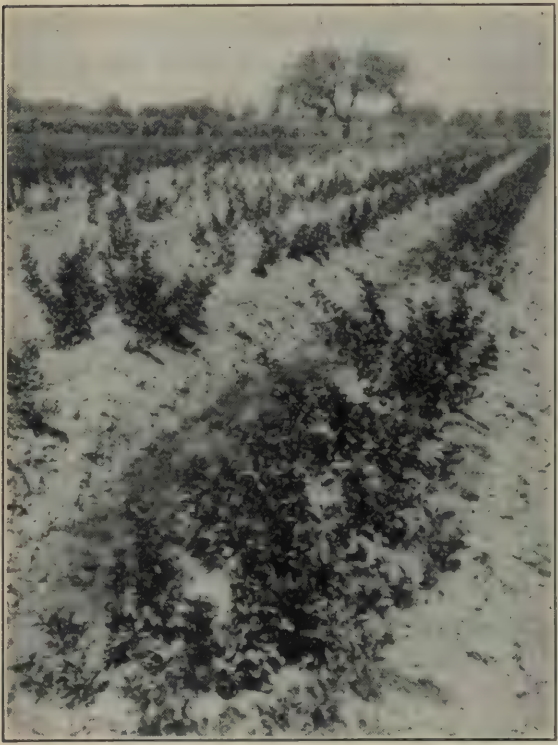

FIG. 2.—A field of gooseberries mounded for propagation by layers. About July 1 the bushes are mounded with soil at least half way to the ends of the branches, following which roots begin forming along the branches. All those which are well rooted may be cut off from the parent plant in the autumn or following spring and grown in the nursery row for one season, or perhaps two seasons, before being permanently planted. (Photographed at Fredonia, N. Y., August 10, 1917.)

Currants are propagated almost entirely by means of cuttings made from vigorous shoots of the current season's growth. In the Eastern States cuttings are made about 8 inches long and in the Pacific coast regions from 10 to 12 inches long. They are usually cut in the autumn after the leaves have dropped and may be set in the nursery row immediately, or buried in sand with the bottom end up, or stored until spring in a cellar cool enough to keep them dormant and moist enough to prevent drying, but not so moist as to cause mold to develop on them. The cuttings may also be made during the winter or in early spring. In the latter case they are put in the nursery at once. The cuttings should be set from 3 to 6 inches apart in the nursery row, with the soil firmly packed about them. This is done as early in the spring as the soil can be worked, whether the cuttings are made in the autumn or later. Not more than two buds should be left above the ground. Figure 3 shows cuttings placed in a trench ready to have the soil packed about them At the end of one or two seasons they should make plants satisfactory for setting in the field. Figure 4 shows a currant bush used for propagation. All the new wood is removed each year to make cuttings.

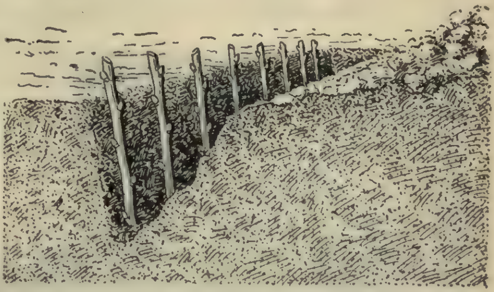

FIG. 3.—Cuttings set in trench.

HANDLING NURSERY STOCK.

Only strong 1-year-old or 2-year-old plants should be used for field planting. Unless the plants can be set at once upon arrival from the nursery, the bundle should be opened and the plants separated and heeled in, as shown in figure 5. This will protect the roots from drying. If the roots are very dry when the plants are received, they should be soaked for several hours before heeling in. Figure 6 shows a bundle of gooseberry plants as received from the nursery.

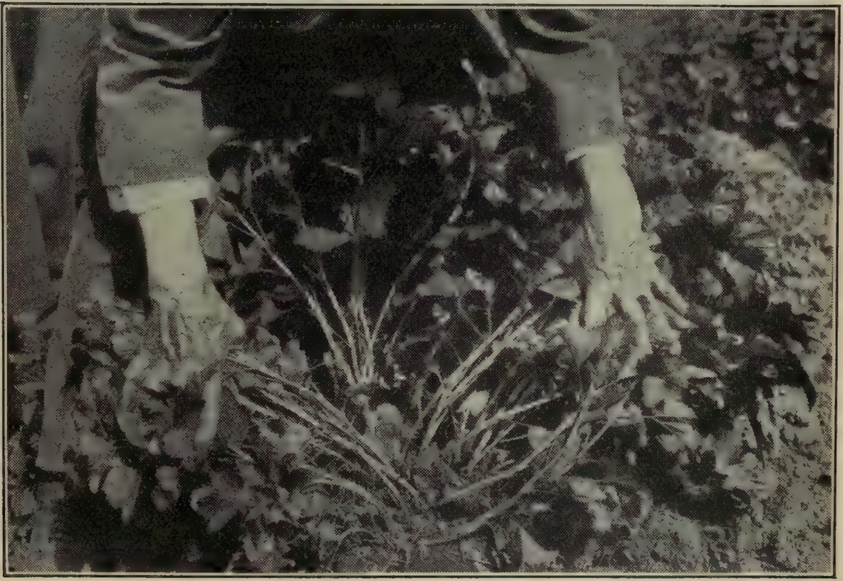

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FIG. 4.—A Cherry currant bush at Fredonia, N. Y., the entire annual growth of which has been cut off each year at the surface of the ground for use as cuttings. This practice insures the maximum growth of new wood for cuttings the following year. Nurserymen may get as many as a hundred cuttings from a single bush. (Photographed August 10, 1917.)

TIME TO PLANT.

In most sections plants may be set either in the autumn or spring, but in northern Iowa and Nebraska and the States north of them only spring planting should be practiced. Both currants and gooseberries start growth very early in the spring, and if nursery stock can be secured in the autumn that season is preferred for planting except in the section just mentioned. In order that the roots may be thoroughly established in the soil before winter, the plants should be set as early as it is possible to obtain them in a dormant condition. Currants may be planted as early as the middle of September in the Northern States, except as noted above, and gooseberries as early as October 1. It is often difficult, however, to purchase plants for autumn setting.

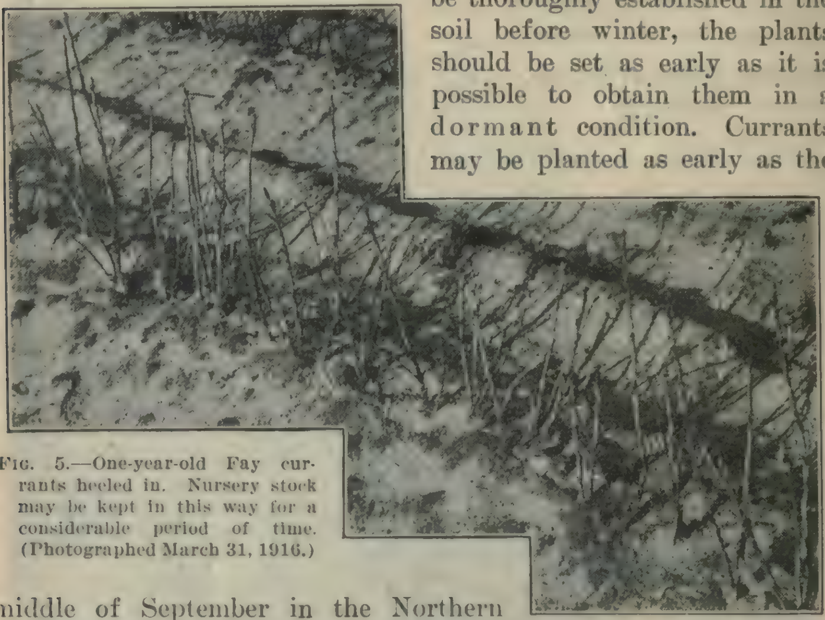

FIG. 5.—One-year-old Fay currants heeled in. Nursery stock may be kept in this way for a considerable period of time. (Photographed March 31, 1916.)

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DISTANCE TO PLANT.

The distance between the rows depends on the method of tillage. If a 1-horse cultivator is to be used, the rows should be set 6 feet apart, while for a 2-horse cultivator the rows should be 8 feet apart.

The distance between the plants in the rows depends to a considerable extent on the variety. If the bushes are of a variety that does not grow large, they may be set as close as 4 feet, while if the bushes are naturally large when fully grown or the ground is very rich 5 or 6 feet apart is preferred. The bushes of the Wilder, London, and some other red currants and of all black currants grow larger than those of the Perfection, Fay, and Red Cross varieties and should be set farther apart in the row. Therefore, if in any section Red Cross bushes are commonly set 5 feet apart in the row the Wilder bushes should be at least 6 feet apart.

The Downing, Houghton, Oregon, and Poorman gooseberries have larger bushes than most others. They may be set 4 or 5 feet apart in soil of ordinary fertility, but in very fertile soil they will need to be 6 or 7 feet apart. Gooseberry bushes of European parentage usually do not grow as large as those mentioned, which are believed to be at least partly of American ancestry, and it is rarely necessary to set them more than 5 feet apart.

DIRECTIONS FOR PLANTING.

Before planting, all broken roots should be cut off and the top cut back to stand about 6 inches above the ground. If the plants have especially strong root systems the tops may be left 10 to 12 inches high. The plants should be set somewhat deeper than they stood in the nursery. If they do not branch naturally near the surface of the ground, they should be set so deep that the lowest branch starts just below the surface of the soil. This will cause them to take the form of a bush instead of a small tree.

The soil must be packed firmly about the roots with the foot as the plants are set. Without such packing the roots may dry out and the plants die.

In friable soils, such as fine sandy loams, the hole for planting may be made by forcing a spade straight down and then pressing it forward. The roots are thrust into this hole, the spade withdrawn, and the soil firmed about them. Plants can be set very rapidly in this manner. In heavy soils holes may have to be dug with a spade

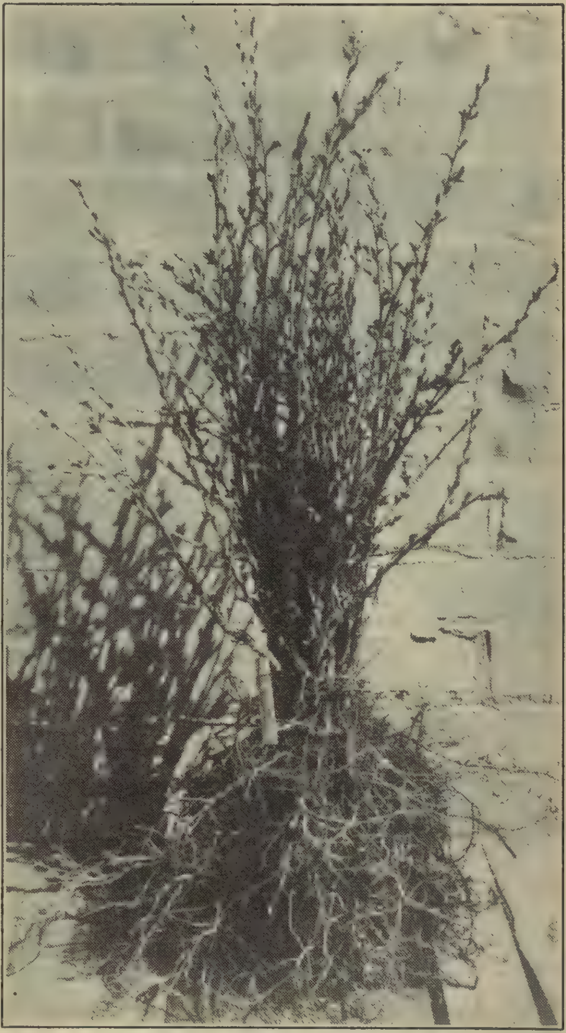

FIG. 6.—A bundle of 27 good plants of the Carrie gooseberry as received from the nursery.

before planting. The cost is then much greater than by the former method, but unless the holes are dug the clay may harden about the roots so that the plants will never grow well.

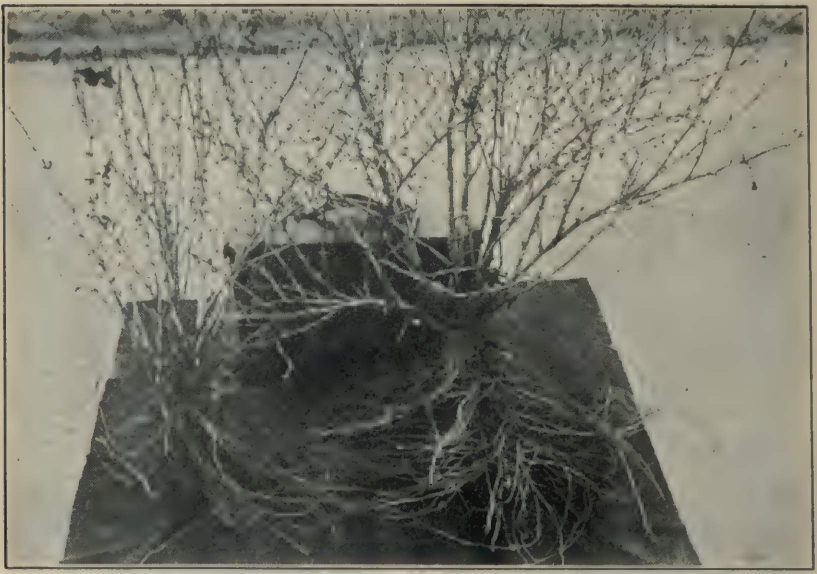

FIG. 7.—An old gooseberry plant (at the right), showing the character of its root system. The plant at the left grew from the tip of a branch of the older plant, which was covered with soil. (Photographed September 26, 1916.)

TILLAGE AND MULCHING.

Tillage should begin soon after the plants have been set and should be continued at frequent intervals throughout the growing season or until a green-manure crop is planted. The tillage should be deeper the first year than later.

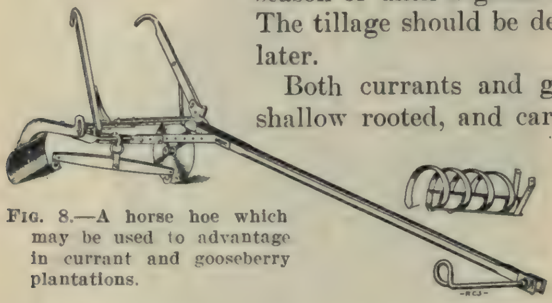

FIG. 8.—A horse hoe which may be used to advantage in currant and gooseberry plantations.

Both currants and gooseberries usually are shallow rooted, and care must be taken not to injure the roots in tillage. If a cultivator is run rather deep the first year the roots may be made to grow somewhat deeper than they otherwise would. The first spring cultivation should be deeper than later ones. Growers sometimes use a plow at this time.

Figure 7 shows the root systems of gooseberry plants grown on land properly tilled. Some of the roots were not more than 6 inches below the surface, but many were over a foot deep.

If plants are set 5 or more feet apart each way a horse-cultivator may be used, and very little hand hoeing will be necessary. If they are set so that the cultivator can be run in one direction only and the rows are 7 or 8 feet apart, a horse hoe, such as is shown in figure 8, may be used. This is easily guided, and if used in connection with the cultivator will reduce the amount of hand labor very considerably.

A mulch of straw or wild hay is sometimes advised for currants and gooseberries. It conserves moisture, keeps down weeds, and takes the place of tillage. Mice are likely to multiply in mulched fields, however, and girdle the plants; in fact, the injury from this source is so often serious that growers rarely use a mulch.

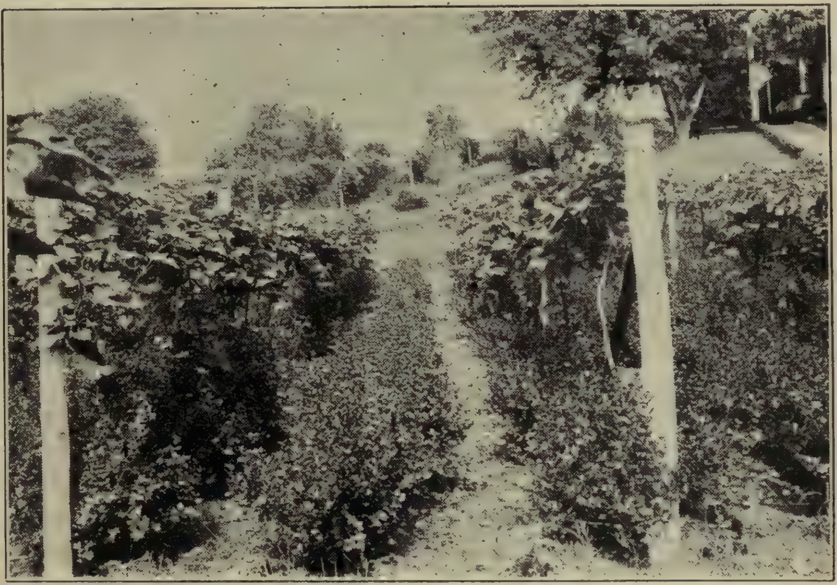

FIG. 9.—Gooseberries interplanted in a vineyard at Marlboro, N. Y. A row of gooseberries is set between the rows of grapes and another row under the grape trellis. These grape rows are 9 feet apart. (Photographed July 20, 1917.)

INTERPLANTING AND INTERCROPPING.

Gooseberries and currants frequently are interplanted in orchards or vineyards. Figure 9 shows gooseberries in a vineyard.

When interplanted in cherry orchards gooseberries and currants may be left for several years, according to the growth of the orchard and the size of the bushes; and in apple and pear orchards they may be left somewhat longer, though the ground occupied should be restricted to one or two rows of bushes through the center of the space between the tree rows. Otherwise, the bushes will be likely to interfere with the proper care of the trees. In vineyards the currants and gooseberries are often made a part of the permanent plantation, but while they are commonly productive when so grown, the grapes are likely to be rather unproductive.

In gardens where the available land is limited in extent, currants and gooseberries may well be planted among the tree fruits and left there permanently. The shade of the trees protects the fruits from sun scald, and the foliage is usually healthier in such locations than when grown where it is freely exposed to the sun. The shade afforded by the fruit trees will be especially beneficial in southern sections, and the currants and gooseberries should be even more productive than if planted by themselves.

When currants and gooseberries are not grown in orchards they may be intercropped for the first two years; that is, vegetables may be grown between the plants in the rows and between the rows. Lettuce, early potatoes, early cabbage, and other early crops requiring intensive cultivation are especially desirable for this purpose. The thorough tillage required by the vegetables is also needed by the berry plants, and the intercrop will often pay for all expenses connected with the care of the plantation.

MAINTENANCE OF FERTILITY.

Both the currant and the gooseberry respond well to the use of fertilizers, even when planted on fertile soils. Their use, however, is governed by the same principles that apply to other crops. The kinds and quantities of the different plant foods that can profitably be used depend on the physical condition of the soil and the plant foods already available in it. The needs in any particular case can be determined only by applying the different plant foods separately and in different combinations to different parts of the plantation and noting the results. Thus, while stable manure and wood ashes can be used in liberal quantities and will generally prove profitable, each grower must determine for himself the amounts that will give the best results on his soil. In like manner the kind and quantities of commercial fertilizer to be used must be determined.

In places where a supply is available, 10 to 20 tons of stable manure per acre each year may be found profitable, and some successful growers use even larger quantities. Many use hen manure. Larger quantities of this may be applied safely to gooseberry plantations than to currants.

In many sections green-manure or cover crops may be used to keep up the humus supply. The seed is sown or drilled in between the rows early enough to allow good growth before winter, and the crop is plowed under early the following spring. If this practice is followed, less stable manure or commercial fertilizer will be needed.

The green-manure crops should be those best adapted to local conditions. Preferably, however, they should consist of legumes or a combination of legumes and nonleguminous plants.

PRUNING THE BUSHES.

Currants and gooseberries naturally form bushes with many branches which start out near the surface of the ground, as shown in figure 10. Too many branches are usually formed. Pruning in a new plantation consists in removing the superfluous ones. It is only rarely that the branches are headed back. The pruning should be done during the dormant period. If not done following the dropping of the leaves in autumn, it is frequently delayed until spring, shortly before growth starts.

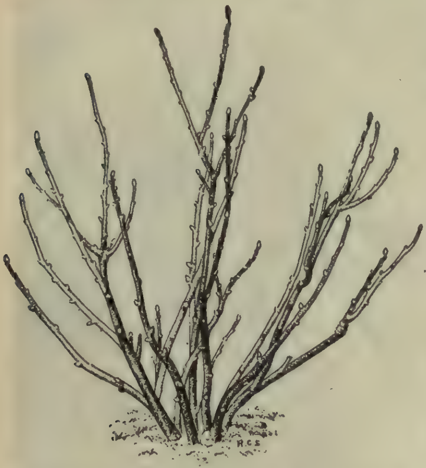

FIG. 10.—A black currant bush before pruning.

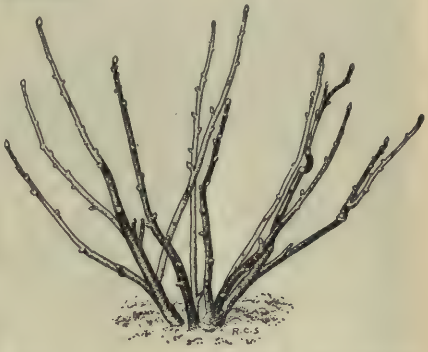

FIG. 11.—The black currant bush shown in figure 10 after pruning. The canes left are all 1 and 2 years old.

PRUNING CURRANTS.

Red or white currant bushes which are 1 year old should have the weaker shoots removed, leaving six to eight strong shoots, according to the vigor of the bush. At the end of the next year four or five 2-year-old shoots and three or four 1-year-old shoots should be left, and at the end of the third year about three shoots each of 3-year-old, 2-year-old, and 1-year-old wood.

The red and white currants bear their fruit at the base of 1-year-old wood and on spurs on older wood. They bear best on spurs on 2-year-old and 3-year-old wood. Pruning bearing bushes after they are more than 3 years of age consequently consists in removing all branches more than 3 years old and which have passed this heavy bearing period, leaving just enough 1-year-old shoots to take their places. Pruning, therefore, in effect is a process of renewal.

In pruning varieties of spreading growth the outer and lower shoots generally should be removed, as these branches are likely to droop to the ground and the fruit borne on them be covered with dirt. Varieties of very erect growth, on the other hand, should be thinned by the removal of the central shoots.

Black currants bear well on 1-year-old wood. In pruning them wood that has borne two years should be removed and new wood left to replace it. Most, if not all, black varieties have an erect habit of growth, and the bushes should be thinned by removing some of the central canes. From six to eight branches are usually left on each plant. Within certain limits the heavier the pruning the larger and better the fruit, yet care is necessary not to go to extremes. Figures 10 and 11 show a black currant bush before and after pruning. These figures also illustrate the plans described above for pruning red currants.

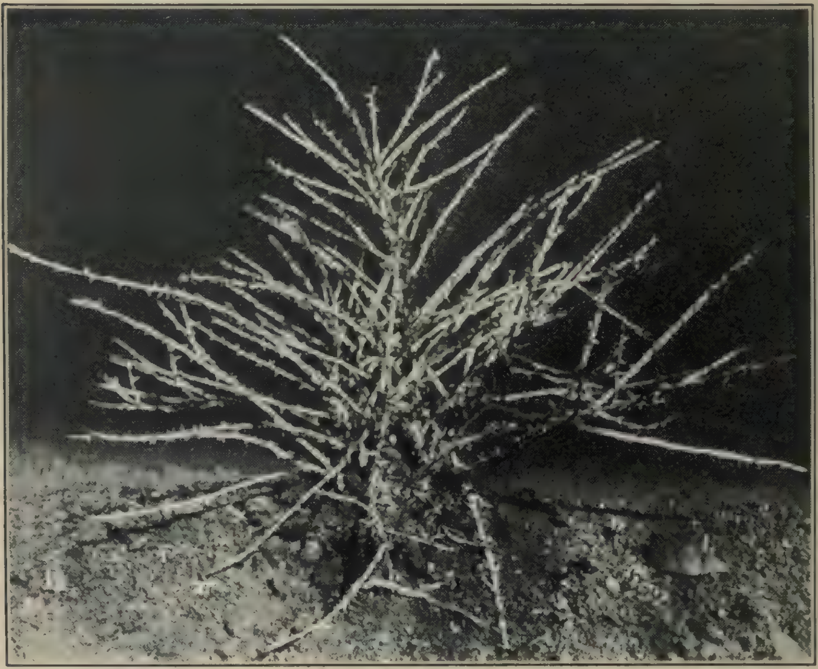

FIG. 12.—A gooseberry bush before pruning. (Compare figure 13.)

PRUNING GOOSEBERRIES.

The general principles of currant pruning apply also to gooseberries. The fruit is produced on 1-year-old wood and on 1-year-old spurs of older wood. Pruning consists in removing branches after they have borne fruit for two years and allowing new shoots to replace them. On the Pacific coast, however, the practice is to allow a branch to fruit for three years before removing it. It is said in that region that the canes are most productive the third year, after which they should be removed. If the side shoots become too numerous, enough of them should be cut out to form a fairly open head. Branches which have borne heavily tend to droop, and these, as well as all other drooping branches, should be removed.

Figures 12 and 13 show a 1-year-old gooseberry bush before and after pruning, while figures 14 and 15 show an older gooseberry bush before and after pruning. This bush was so vigorous that more than nine branches were left.

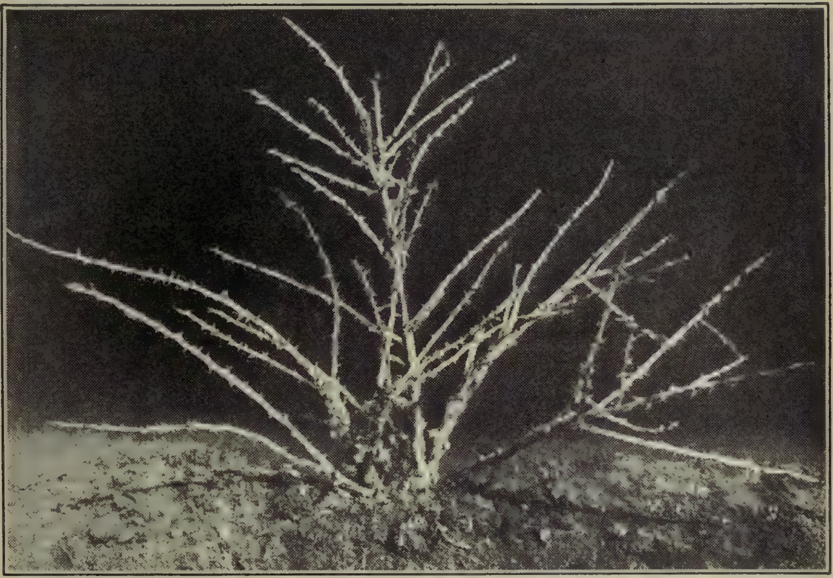

FIG. 13.—The gooseberry bush shown in figure 12 after pruning. All branches lying on or close to the ground have been removed and those remaining have been thinned out.

Plantations of gooseberries trained to the tree form, where all the branches start from a main stem at a height of 1 or 2 feet above the ground, have been comparatively unproductive in the United States. As the bush form, where all the branches start from the root at or just below the surface of the ground, is more productive, and as the gooseberry naturally grows in that form, it is the only one discussed here.

Figure 16 shows a gooseberry plant grown in the tree form and figure 17 one in bush form.

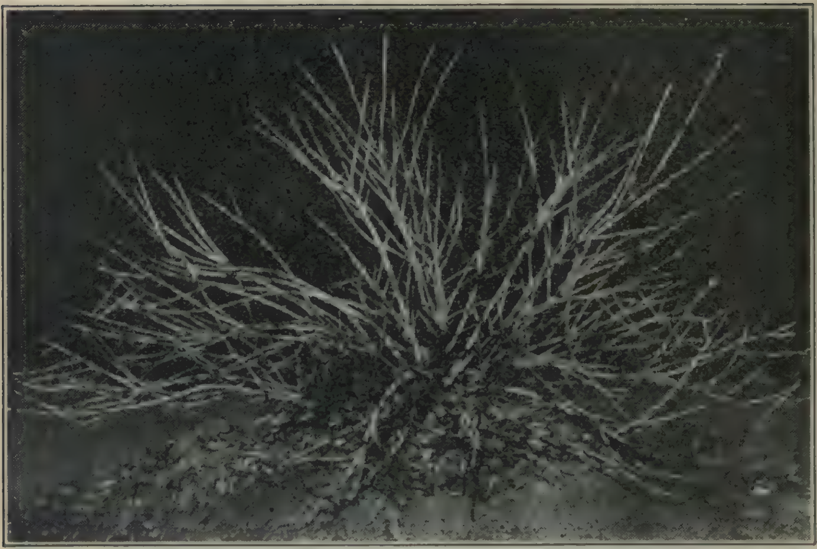

FIG. 14.—A 2-year-old bush of the Van Fleet gooseberry before pruning. See figure 15. (Photographed October 22, 1915.)

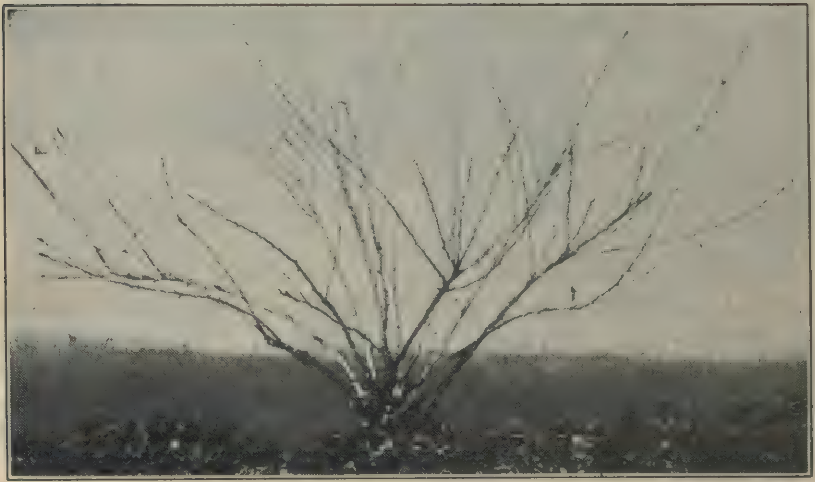

FIG. 15.—The 2-year-old Van Fleet gooseberry bush shown in figure 14 after pruning. The branches lying on the ground were removed and the top thinned. (Photographed October 22, 1915.)

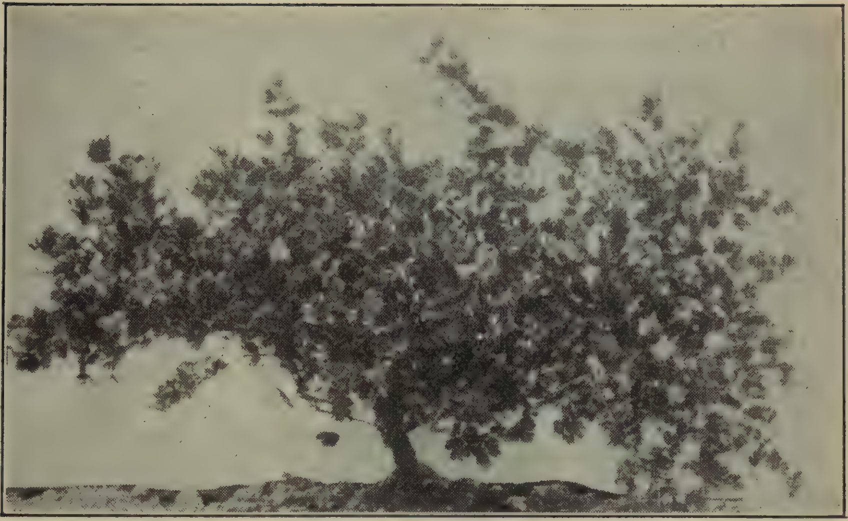

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FIG. 16.—A plant of the Jolly Angler gooseberry at Geneva, N. Y., trained to the tree form. This form is not as desirable as the bush form shown in figure 17. (Photographed July 23, 1917.)

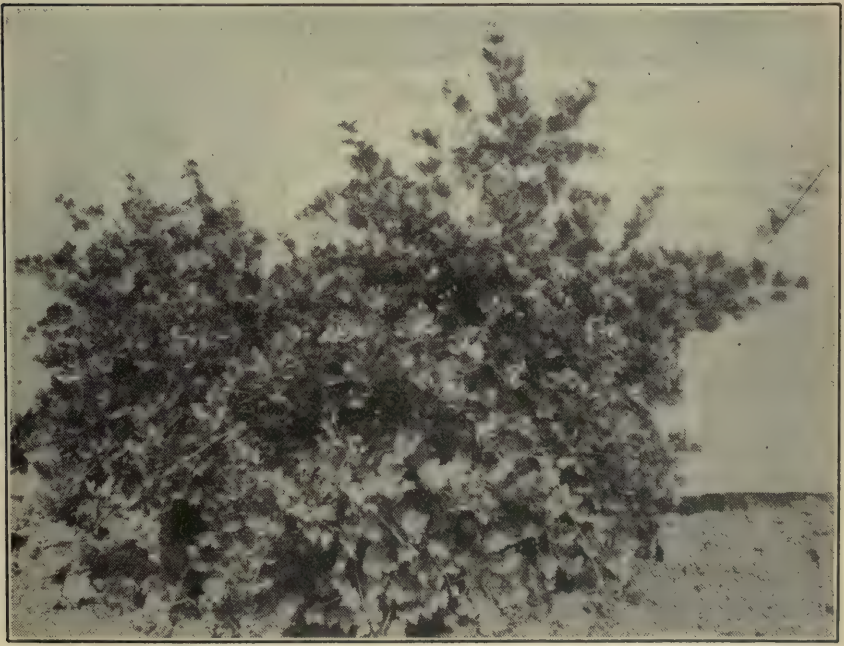

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FIG. 17.—A plant of the May Duke gooseberry at Geneva, N. Y., trained to the bush form. The branches start at or below the surface of the ground. (Photographed July 23, 1917.)

INJURIOUS INSECTS.[1]

THE SAN JOSE SCALE.[2]

The San Jose scale is at times destructive to currants and gooseberries. Infested plants become yellowish and unthrifty, many of the canes eventually dying. Plants seriously attacked will have a grayish appearance, as if coated with ashes. Individual mature female scales are about the size of a pinhead, circular in outline, with a nipplelike prominence in the center. (Fig. 18.)

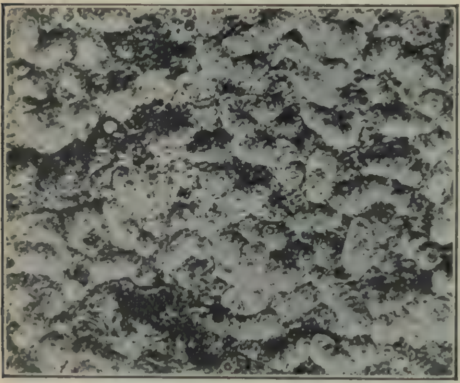

FIG. 18.—The San Jose scale. (Much enlarged.)

Thorough spraying of the infested plants each year during the dormant period with lime-sulphur concentrate, at the rate of 1 gallon to 7 or 8 gallons of water will keep under control these insects, as well as the oyster-shell scale, also common on currants.

THE IMPORTED CURRANT WORM.[3]

The imported currant worm when full grown is about three-fourths of an inch long, green throughout, but yellowish at the ends. Young larvæ are covered with black spots, and the head is black. (Fig. 19.) These worms attack both currants and gooseberries, appearing on the plants shortly after the leaves are out in the spring and feeding at first in colonies, but later scattering over the plants. Currant worms are voracious feeders and quickly strip the plants of foliage; hence, treatment should be given promptly upon their discovery. Another brood of larvæ appears in the early summer, and some seasons there may be a partial third brood. These insects are destroyed readily with an arsenical (such as arsenate of lead paste at the rate of 2 pounds, or in powder form at 1 pound, to 50 gallons of water), sprayed or dusted over the plants. Effort should

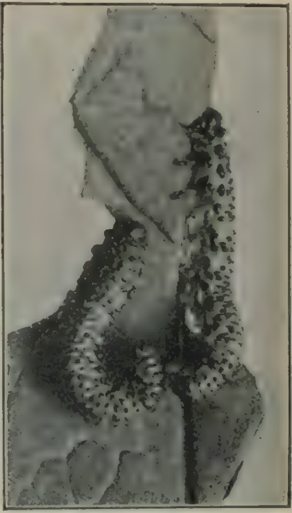

FIG. 19.—The imported currant worm and its injury to currant leaves.

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[1] Prepared by A. L. Quaintance, entomologist in charge of deciduous-fruit insect investigations, Bureau of Entomology.

[2] *Aspidiotus perniciosus* Comstock.

[3] *Pteronus ribesii* Scopoli.

be made to destroy the first brood and prevent later injury. In treating the second brood when the fruit is ripening, powdered hellebore should be used, diluted 5 to 10 times with flour or air-slaked lime, or as a spray, 1 ounce to 1 gallon of water.

THE CURRANT APHIS.[1]

The currant aphis curls the terminal leaves of the currant and gooseberry, especially the red currant, its presence resulting in little pits or pockets on the lower leaf surface. (Fig. 20.) A reddish color usually develops on the upper surface of injured leaves, which is visible some distance away. This aphis is easily controlled by spraying the plants as the leaf buds are opening in the spring, thus destroying the young stem mothers. The 40 per cent nicotine sulphate at the rate of 1 part to 800 or 1,000 parts of soapy water should be used, or kerosene emulsion or fish-oil soap wash may be used instead. Where the nicotine is used in small quantities, 1 teaspoonful to a gallon of water, or 1 ounce to 8 gallons makes the right proportions. In spraying later in the season the liquid should be directed against the insects on the lower surface of the leaves.

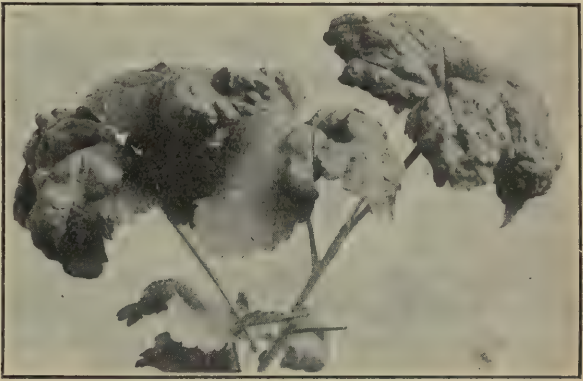

FIG. 20.—Currant leaves curled by the currant aphis.

THE IMPORTED CURRANT BORER.[2]

The larvæ of the imported currant borer attack the canes, principally of the currant, eating out the pith, the hollows or burrows often being several inches in length. The injured canes in the spring put out a sickly growth, owing to their weakened condition, and may break from the action of the wind.

The parent insect is a handsome clear-winged moth, with a wing expanse of about three-fourths of an inch. These insects are out during June and deposit singly on the plants their brownish, round eggs. The resulting larvæ bore into the canes, tunneling up and down as they grow, becoming nearly full grown by fall, when they are about one-half inch long, whitish in color, the head and legs brown. The larvæ hibernate in their burrows, complete their growth the following spring, and then pupate. In May or early June the moths emerge, completing the life cycle of the insect.

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[1] *Myzus ribis* Linn.

[2] *Sesia tipuliformis* Clerck.

This pest is best controlled by cutting out and destroying in the spring the sickly and weakened canes. If this work be carefully done each year it will aid much in keeping the insects reduced below injurious numbers.

THE YELLOW CURRANT FLY.[1]

The maggot of this small pale yellowish fly infests the fruit of both the currant and gooseberry, causing it to color prematurely and usually fall to the ground. Infested berries generally show a discolored spot at the place punctured by the female in depositing the egg or marking the location of injured seeds. This insect occurs over the northern United States and Canada, but is more troublesome in the West, where in some regions it is practically a chronic pest. The maggots require about three weeks to complete their growth. Then they desert the berries either while these are hanging on the plants or after they have fallen to the ground, change to the pupal stage at or below the ground surface, and remain in this condition until the spring following, when the adults appear and deposit eggs in the developing fruit.

No practical method of controlling this pest is known. Benefit, of course, according to the thoroughness with which the work is done, will follow the careful removal from the bushes and the destruction of the prematurely ripening fruit.

DISEASES.[2]

The fungous diseases of the currant ana gooseberry are much the same and are rather generally distributed throughout the areas where these plants are grown. Descriptions of the most important diseases follow.

CURRANT DISEASES.

Cane wilt.—The fungus[3] causing cane wilt usually enters the plant through a terminal or lateral bud or a small branch on a cane and soon reaches the main stem, completely cutting off the water supply of the upper part and causing the leaves and fruit to wilt and die. The death of the cane may occur at any time during the growing season, but is most frequent and conspicuous about the time the fruit is ripening. This disease at present appears to be confined chiefly to New York and New Jersey. No noticeable difference in the susceptibility of different varieties has been observed.

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[1] *Epochra canadensis* Loew.

[2] Prepared by C. L. Shear, pathologist, Office of Fruit Disease Investigations, Bureau of Plant Industry.

[3] *Botryosphaeria ribis* Gross. and Dug.

Treatment.—The attempts to prevent or control this disease have thus far not been very satisfactory. A combination of eradication and spraying is the best treatment that can be recommended. As a sanitary measure, at least, all diseased canes should be cut out and destroyed by burning as soon as discovered, and in the fall all canes dead and dying from any cause should be removed and burned. In addition to this, the spray treatment with Bordeaux mixture given later in the spray schedule for anthracnose and leaf-spot should help to prevent new infections. The dormant spray with lime-sulphur for scale insects should also be helpful.

Anthracnose.—Anthracnose is caused by a parasitic fungus[1] which at first produces numerous small brownish spots thickly scattered over the upper surface of the leaves. As the disease progresses, the leaves turn yellow and drop. In severe cases the bushes may be defoliated before the fruit has ripened. Sometimes also the fruit stalk and fruits are attacked by the fungus. In less severe cases the foliage may not fall until after the fruit has matured. The canes, however, do not mature properly in either case and are much weakened and more liable to winter injury and fungous diseases than normal vigorous canes. Some varieties are more subject to attack by this disease than others. The Albert (*Prince Albert*) and the Wilder varieties are said to be usually free from attack, while the Fay and the Victoria are likely to be badly affected.

Treatment.—The dormant spray with commercial lime-sulphur, 1 to 10, as commonly used for scale insects, is very helpful in controlling anthracnose. During the growing season the plants should be sprayed with Bordeaux mixture in accordance with the spray schedule on a following page. In severe cases it may be necessary to spray after the fruit has been picked, in order to prevent premature defoliation. Spraying just before the fruit is ripe may result in staining and necessitate washing.

Leaf-spot.—Leaf-spot[2] is characterized by the appearance of irregular spots, having a pale center and brownish purple margins. Minute brownish black pustules of the fungus are produced on the under sides of the spots on the leaf. These pustules are the fruiting bodies of the parasite. The spots may become so numerous on the leaves that the plants are more or less defoliated. This trouble is not often as serious as in the case of anthracnose, and the leaves do not usually fall until late in the season. Where there is defoliation, however, there is injury to the plant and a decrease in its productivity.

Treatment.—The treatment for leaf-spot is the same as that for anthracnose, as given in the spray schedule.

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[1] *Pseudopeziza ribis* (Lib.) Kleb.

[2] *Septoria ribis* Desm.

Angular leaf-spot.—Angular leaf-spot[1] is usually less frequent and less serious than the other leaf troubles. The spots produced by the fungus are scattered, roundish, or angular, and ashy or whitish.

Treatment.—The spray treatment recommended for anthracnose will also prevent angular leaf-spot. (See spray schedule.)

Powdery mildew.—Besides the above diseases, powdery mildew of the gooseberry sometimes occurs on the currant, but it is rarely of sufficient importance to require treatment.

GOOSEBERRY DISEASES.

Powdery mildew.—Powdery mildew[2] is not usually severe on American varieties of the gooseberry. It is most serious on European varieties or hybrids with European varieties. The fungus first appears in the form of a white, more or less powdery growth on the young leaves and shoots as well as fruit. As it develops further it forms a thin, felty, reddish brown coating of fungous filaments on the fruit, foliage, and stems.

Treatment.—The most satisfactory treatment for powdery mildew is commercial lime-sulphur, 1½ gallons to 50 gallons of water. Three or four applications should be made, beginning as soon as the leaf buds begin to open and repeating at intervals of 10 to 14 days. Where the attack is severe, the cutting out and burning of the diseased tips of the canes should be practiced, as the fungus lives over winter in these diseased parts.

Anthracnose.—Anthracnose[3] of the gooseberry is caused by the same fungus and presents the same general appearance as anthracnose of the currant. It is, however, usually less serious on the gooseberry.

Treatment.—Spraying with Bordeaux mixture, in accordance with the directions in the spray schedule for currant anthracnose, will control this disease.

Leaf-spot.—Leaf-spot[4] has practically the same appearance on the gooseberry as on the currant and is caused by the same fungus. It sometimes defoliates the plants.

Treatment.—It can be controlled by giving the treatment directed in the spray schedule for currant leaf-spot.

WHITE-PINE BLISTER RUST.[5]

The invasion of North America by the white-pine blister rust has brought about in many States new laws and quarantines regulating the shipment, planting, or possession of currants and gooseberries. During the next few years similar restrictions are likely to be in effect in other States and in other areas within States which at present have such laws. The cultivation of currants and gooseberries in the New England States, New York, Pennsylvania, the Appalachian Mountain region of the Southern States, Michigan, Wisconsin, and Minnesota should be limited to such localities as are approved by the State agricultural and forestry departments. In other States these plants should not be grown in proximity to native or planted white pines. The cultivated black currant should not be grown within the white-pine region, because of its extreme susceptibility to this disease. There are no legal limitations to the general cultivation of currants and gooseberries in the Middle West or in the Rocky Mountain and Pacific Coast States, except Federal and State quarantines against the importation of these plants from the Eastern States and from foreign countries.

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[1] *Cercospora angulata* Wint.

[2] *Sphacrotheca mors-uvae* (Schw.) B. and C.

[3] *Pseudopeziza ribis* (Lib.) Kleb.

[4] *Septoria ribis* Desm.

[5] Prepared by S. B. Detwiler, forest pathologist, Office of Forest Pathology, Bureau of Plant Industry.

White-pine blister rust was brought into the United States on nursery stock from Europe and is permanently established in the East. Infection is general in the New England States and in the eastern Adirondack region of New York. Isolated spots of the disease have been found as far south as New Jersey and Pennsylvania and as far west as South Dakota. The disease is also prevalent in the Provinces of Ontario and Quebec, Canada.

The white-pine blister rust is a fungus which grows on the leaves of currants and gooseberries and then attacks and kills 5-needled pines. The best regions for the growing of currants and gooseberries in most cases are also the regions in which white pines are native and climatic conditions favorable to the development of the parasite. If the disease is present in localities where it is desirable to continue the growing of white pines, it is a necessary step in control to destroy all currant and gooseberry bushes (both cultivated and wild) within a third of a mile of the pines.

The blister rust first attacks the twigs of a pine tree and then gradually works into the larger branches and the trunk. It kills by girdling the bark. No tree infected with this disease has ever been known to recover. Fortunately for its control, the blister rust can not go directly from one tree to another. It requires a period of incubation on the leaf of the currant or gooseberry, where it undergoes several changes, before it can again attack pines.[1] Its growth on currants and gooseberries is so vigorous that by the end of a growing season it may have spread to most of the bushes within a radius of several miles of the infected pines on which it originated. When white pines grow near infected currants or gooseberries the disease passes back and forth from one host to the other until all of the trees are hopelessly diseased.

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[1] For a complete description of this disease, see Farmers' Bulletin 742, entitled "The White-Pine Blister Rust."

No species or variety of currant or gooseberry appears to be immune to the rust. Cultivated black currants are especially susceptible. Spraying has not proved practical or successful in preventing infection or in killing the fungus after it attacks the currant or gooseberry leaves. Ordinarily, the bushes are not killed by the disease, but plants which are heavily infected lose their leaves in midseason and crop production is reduced accordingly.

For practical control of this disease it is necessary to remove immediately either all 5-leaved pines or all currants and gooseberries from the region. Experience has proved that this disease can not be controlled by cutting out only infected trees or parts of trees. If currant and gooseberry bushes are to be kept free from disease it is essential to remove all 5-leaved pines as soon as the blister rust appears in a district. To safeguard any particular group of pines when infection appears on currants and gooseberries, the only effective method is to uproot all currants and gooseberries, wild and cultivated (including ornamental, flowering, or "spice" currants), within a third of a mile of the trees it is desired to protect. The removal of these bushes only when the disease is found on them is expensive, because of the frequent inspections which are required. It is, furthermore, ineffective, because it is practically impossible in actual work to make inspections thorough enough and often enough to detect all cases of disease, and some spores are almost certain to escape to the pines.

The general prevalence of blister-rust infection in New England and northeastern New York makes it necessary for these States to regulate the cultivation of currants and gooseberries in order to protect the pines. A number of States have enacted laws permitting State officials to destroy all cultivated currants and gooseberries in certain districts or in the entire State and to prohibit the future planting of currants and gooseberries in control districts. The purpose of these laws is to enable the owners of valuable white-pine woods to cooperate with the State officials in protecting them.

The New York law designates as "fruiting-currant districts" those sections of the State where the growing of currants for the production of fruit is an important commercial enterprise. The State conservation commission and the State department of agriculture are directed to designate the boundaries of such districts, and thereafter may prohibit the possession or planting of 5-leaved pines in these areas. In these districts, all currant and gooseberry bushes infected with the blister rust may be destroyed. Any wild or cultivated currants and gooseberries may be destroyed outside of the "fruiting-currant districts," for the purpose of controlling the white-pine blister rust. This State also has declared all species of cultivated black currants (including flowering currants) a public nuisance and has prohibited their possession outside of the fruiting-currant districts.

Many States have quarantine regulations prohibiting the introduction of currant or gooseberry stock from designated regions. The Federal Horticultural Board also has placed an embargo on all currant and gooseberry plants from foreign countries, besides prohibiting interstate shipments in specified zones. It has been found that occasionally the blister rust fruits on the green stems of wild gooseberries as well as on the leaves. Scientific as well as circumstantial evidence points strongly to the wintering of the disease on currant and gooseberry bushes. In this way currant and gooseberry nursery stock may be responsible for introducing the disease into new localities.

Undoubtedly other States where the white pine has a large present and potential value will follow the lead of New York and limit the propagation of currants and gooseberries to designated areas. In each locality the determining factor will be whether the currants and gooseberries or the white pines are of greater value. Since the white pines of the United States are estimated to be worth $423,000,000 and those of Canada $200,000,000 additional, it is felt that no chances of a further spread of the blister rust can be taken. The value of the young white-pine growth which will speedily succumb to a general infection of this disease is far in excess of the total value of the currant and gooseberry industry of the United States.

It is hoped to keep the white-pine blister rust out of the forests of the Rocky Mountain and Pacific Coast States through the Federal order prohibiting the shipment of any 5-leaved pines or currants or gooseberries from the Eastern States. Since the laws and quarantines relating to the shipment, planting, and growing of currants and gooseberries are likely to be changed frequently during the next few years, the prospective planter should communicate with the nursery inspector of his State before investing in nursery stock or establishing a plantation.

SPRAY SCHEDULE.

DORMANT TREATMENT.

Just as the buds begin to swell, spray with lime-sulphur concentrate at the rate of 1 gallon to 7 or 8 gallons of water. This is for the control of the San Jose and other scales and is of some value in preventing fungous diseases.

FOLIAGE TREATMENT.

First application.—Just as the leaves are unfolding in the spring, spray with Bordeaux mixture, 4–4–50.[1] This treatment is for the cane wilt, anthracnose, and leaf-spot.

Second application.—Ten to twelve days after the first treatment spray with Bordeaux mixture, 4–4–50, plus 2 pounds of arsenate of lead paste (or 1 pound of arsenate of lead powder) to 50 gallons of spray. This is for the control of the fungous diseases mentioned and also for the imported currant worm.

Third application.—Twelve days to two weeks after the second treatment spray with Bordeaux mixture, 4–4–50, plus 2 pounds of arsenate of lead paste (or 1 pound of arsenate of lead powder) to 50 gallons of spray. This is for the control of the troubles mentioned under the second application. In gardens it will be safer to use hellebore than arsenate of lead to control the imported currant worm, especially at the time of this application. (See page 19 for directions.)

NOTE.—In cases where the powdery mildew is serious, dilute lime-sulphur concentrate at the rate of 1½ gallons to 50 gallons of water should be used instead of Bordeaux mixture, as previously stated.

DURATION OF A PLANTATION.

If a currant or gooseberry plantation is properly cared for, at least 8 to 10 crops may be expected before it becomes unprofitable because of its age. Productive fields over 20 years old are not uncommon in some sections. Although the number of years a plantation will continue in good bearing condition depends to some extent upon location and soil, the most important factor is the care which it receives. The period of productiveness of both currant and gooseberry plants is longer in northern regions than toward the southern limits of their culture and longer on heavy soil than on sandy soil.

HARVESTING THE CROP.

Currants and gooseberries may be left on the bushes for a long time after they are ready for use, from four to six weeks in the case of gooseberries, and with some varieties of currants even longer. For fruit which is to be marketed, however, the picking season is shorter, its length depending upon the variety.

Fruit which is intended for the general market should be picked and handled with great care. Injury to the skin furnishes an opportunity for the development of molds and bacteria which cause the fruit to spoil very quickly. There is also in the case of currants a leakage of the juice, which makes them unattractive and causes dust and dirt to adhere to them.

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[1] Copper sulphate (bluestone), 4 pounds; stone lime, 4 pounds; water to make 50 gallons of spray.

Quart baskets are often used as containers in picking. They may be set in hand carriers or in frames which are attached to the belt or suspended from the shoulders of the picker.

Currants should be picked by separating the stem of the cluster from the branches with the fingers, and not by grasping the clusters of berries and pulling them off. The berries are easily crushed and should never be pressed in picking. Certain varieties develop no berries at the base of the fruit cluster, that is, on the part next to the branch or spur, and these can be easily picked without danger of crushing. This is an especially desirable characteristic in a variety grown for market purposes.

When currants are to be used for making jelly they should be slightly underripe, as in that stage of maturity the berries contain more pectin (the substance in the juice of fruit which enables it to form jelly) than when thoroughly ripe. This is especially necessary with the Perfection, Red Cross, and other sorts which become rather mild flavored when fully ripe. If the fruit is to be spiced, stewed, or used for jam, it should be fully ripe when picked.

In this country gooseberries are usually picked before they are fully ripe. As soon as they are completely grown, which, in general, is about the time red raspberries begin to ripen, they may be picked for the canning factory or for jelly or jam making. When used for these purposes they may be stripped by hand, or a scoop resembling a cranberry scoop may be employed in picking. Gloves are worn when stripping the berries from the branches. In stripping, the berries are mixed with leaves, which are cheaply removed by passing through a grain-fanning mill, as shown in figure 21.

When gooseberries are intended for the general market they should not be stripped from the branches, as the sharp thorns cut many of the berries and these quickly spoil. Large-fruited berries must be handled with special care in order to avoid injuries. When fancy prices are secured for these large-fruited sorts, the bushes are sometimes picked over twice. After the full-grown berries are removed at the first picking, the small ones quickly increase in size and are ready for picking in a few days. They are usually marketed in quart baskets; more rarely in pint baskets.

In Europe large quantities of ripe gooseberries are eaten out of hand. Venders and fruit stores sell them in paper sacks and other containers, as cherries are sold in this country. In the United States, however, gooseberries are not commonly eaten without cooking, although many sorts are delicious when ripe and rank among the best dessert fruits. In fact, in this country gooseberries are most commonly used in the green state for stewing and making jams, preserves, jellies, and pies. As gooseberries are of different colors when ripe and vary in their season of maturity, it will be necessary to learn by experience the proper time to pick each sort.

Gooseberries sun scald very quickly after picking and should be kept in the shade. Berries left in bright sunshine for half an hour or even less are likely to sun scald badly.

Figures 22 and 23 show crates of currants and gooseberries ready for market.

YIELDS OF FRUIT.

The currant as a rule bears abundant annual crops. Good plantations in full bearing should yield not less than 100 bushels per acre annually. Yields of 300 bushels per acre are exceptional, but have been recorded. Good plantations of gooseberries of European parentage should yield at least 100 bushels per acre. Those of American or partly American parentage are generally more productive, and yields of 300 bushels and more per acre are not unknown. European varieties, however, usually sell for much higher prices than American varieties.

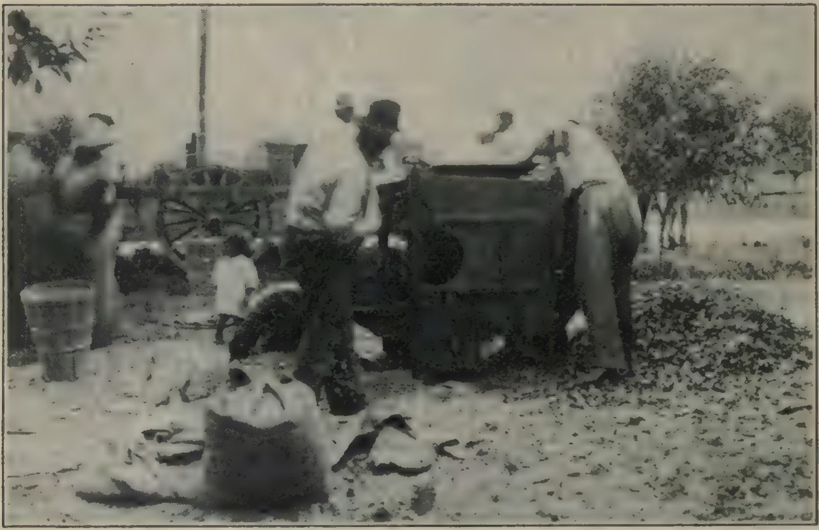
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FIG. 21.—A fanning mill through which gooseberries are passed as they are received from the pickers, for the purpose of removing the leaves that are mixed with them in harvesting the fruit. (Photographed June 16, 1915, at Rancocas, N. J.)

Bushes in gardens usually receive more intensive cultivation than those in large plantations and therefore yield more as a rule. Currant bushes under garden conditions often yield from 5 to 10 quarts each, and gooseberries even more.

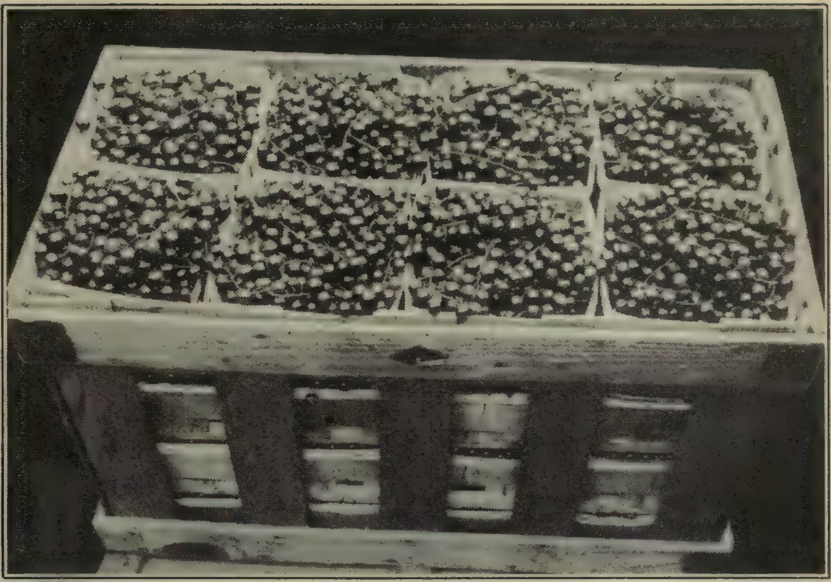

FIG. 22.—A 32-quart crate of Perfection currants ready for market. Note the relatively large size and long stems of this sort. (Photographed July 20, 1915, at Westwood, Mass.)

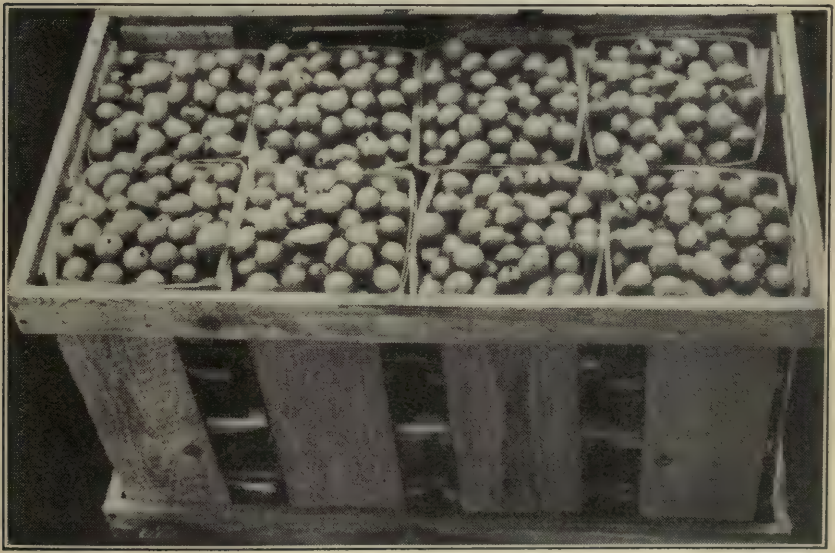

FIG. 23.—A 32-quart crate of Columbus gooseberries at Middle Hope, N. Y. Note the large size of this variety, which is one of the most desirable of the European sorts. (Photographed June 23, 1915.)

VARIETIES.

CURRANTS.

For commercial plantations vigorous, erect-growing, productive varieties should be chosen. The more acid varieties should be selected for jelly making and the milder varieties for dessert uses. The fruit should be large and firm and borne in compact clusters. Deep-red varieties are preferred for the market. For dessert use in the home the white currants are considered best.

The following varieties are suggested for the sections named: Perfection, Wilder, Red Cross, and White Imperial for the northeastern part of the United States; London (*London Market*), Wilder, Red Cross, and Perfection for Michigan and other parts of the Middle West; Perfection, London (*London Market*), Red Cross, Wilder, Fay, and Victoria for the Pacific coast.

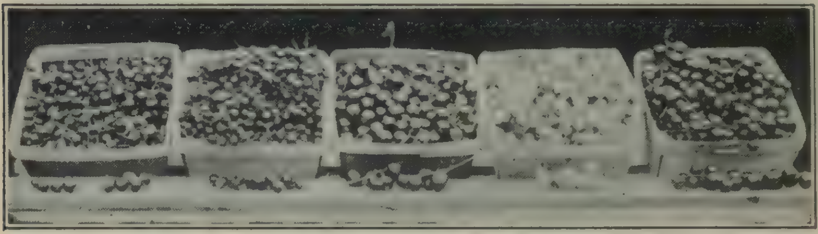

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FIG. 24.—Boxes of several varieties of currants, with clusters of each variety in the foreground. The varieties represented are (from left to right) the Lee (black), Albert (red), Champion (black), Margeson (white), and Perfection (red). (Photographed July 20, 1915, at Westwood, Mass.)

The varieties mentioned are suggestive only. In certain localities in the regions specified other varieties may be better adapted. The Fay, Perfection, Cherry, White Grape, Red Cross, and London have been found entirely hardy in North Dakota and should be hardy anywhere in the United States.

Most growers prefer to plant but one or two varieties. If two varieties are used, an early and a late one are selected.

Figure 24 shows the character of the fruit of several varieties of currants, while figure 25 shows a branch with the characteristic short clusters of the black currants.

RED VARIETIES.

Albert (*Prince Albert*).—Berries small to medium, very acid; hang on bushes well; season late. Clusters short, compact. Bushes very upright. One of the best varieties for jelly and preserves and the latest maturing sort listed here, except perhaps the Rivers.

Cherry.—Berries large, becoming smaller as the bush grows older; deep red; very acid; midseason. Clusters vary in length and compactness; not as easily picked as Fay. Bush somewhat spreading.

Diploma.—Berries very large, bright red, mild subacid; clusters easily picked. Bush upright; canes rather brittle. A promising comparatively new variety.

Fay.—Berries large, dark red, acid; early to midseason. Clusters with small berries at ends; easy to pick. Bush very spreading; canes break easily. Needs fertile soil. One of the leading varieties in New York.

Filler.—Berries large. Bush upright. Grown somewhat in the Hudson River Valley.

Franco-German.—Berries medium size, acid; season late. Clusters small, compact. Bush upright. Desirable for dry western climates.

London (*London Market*).—Berries medium to large, deep red, very acid; midseason to late. Clusters compact. Bush upright. Somewhat resistant to borers and diseases; reported as the most resistant of any variety to the white-pine blister rust. The best variety in many sections of the Middle West.

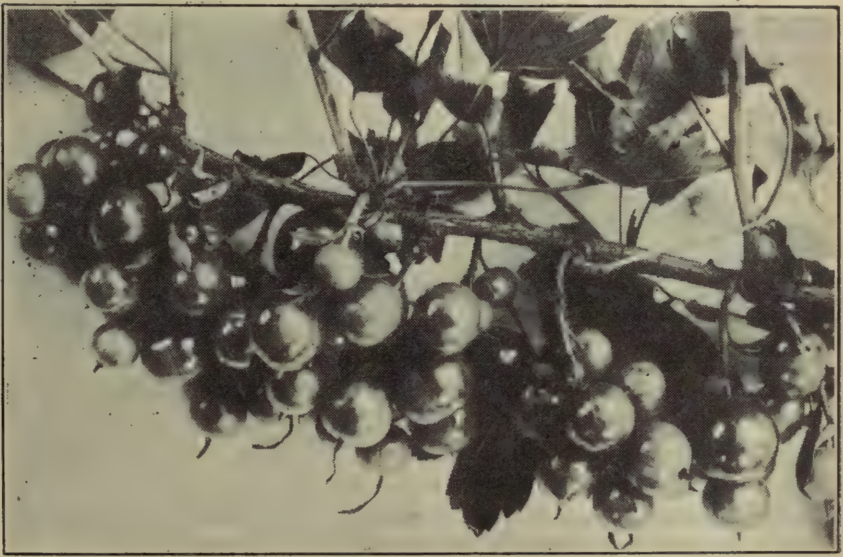

Fig. 25.—A branch of the Golden Prolific currant. This is a variety of the species *Ribes aureum,* which is native to western Kansas and Oklahoma, eastern Colorado, and surrounding regions. Varieties of this species are very productive under some conditions, but under other conditions are unproductive. (Photographed June 30, 1917.)

Perfection.—Berries large, bright crimson, sprightly subacid; midseason. Clusters compact, long, easy to pick. Bush upright; canes break easily. A very promising variety for all sections and the best variety in parts of the Northwest.

Red Cross.—Berries large, firm, light red, subacid, hang on bushes well; midseason, but later than Cherry. Clusters large, long, compact, very easy to pick. Bush somewhat spreading. A desirable variety in most sections, although cracking so badly at one point in the Hudson River Valley that it has been discarded. Not so good for jelly as others.

Rivers (*Rivers Late*).—Berries medium to large; hang on bushes well; season late. Clusters large. Bush large, upright, similar to that of Albert. A new sort. Promising because of its large fruit, which ripens late in the season.

Victoria.—Berries medium size, bright red, mild subacid; hang well on bushes. Clusters long, loose. Bush upright, large, very free from diseases and most insects, but susceptible to hot-weather injury in some sections; very productive and very hardy. The Victoria, Albert, Rivers, and London are especially good for prolonging the season.

Wilder.—Berries large, dark red, mild subacid; hang on bushes well; midseason. Clusters large, compact, easy to pick. Bush upright and large. A desirable variety and hardy in all regions except the upper Mississippi Valley region.

WHITE VARIETIES.

White Grape.—Berries large, pale yellow, very mild flavor. Clusters loose and poorly filled. Bush spreading.

White Imperial.—Berries large, pale yellow, almost sweet. Clusters medium size. Bush spreading, very productive. A desirable variety; considered to have the best dessert quality of all currants.

BLACK VARIETIES.

Boskoop (*Boskoop Giant*).—This is a comparatively new currant of value. The berries are large, good in quality, and ripen evenly; the clusters are large for a black sort and pick easily; the bush is productive. One of the earliest black sorts.

Crandall.—Berries large, bluish black, with a characteristic flavor somewhat unlike other black sorts. Clusters rather small. Bush spreading. Succeeds in regions having hot summers. The Golden Prolific is a variety similar to the Crandall, but with golden fruit. The berries of both these sorts must be picked singly, as they do not all ripen at the same time.

Naples.—The fruit of this variety is smaller than that of the Boskoop, and it is not always productive. It is commonly grown, however.

GOOSEBERRIES.

As already stated, the American varieties of gooseberries are usually the most productive. They are hardier and are considered by most Americans to be of better quality. The European varieties are larger and sell much better in the market, but are rather subject to mildew, though this disease is not generally so serious as is commonly supposed. Because of the much higher prices usually paid for the European varieties they will be more profitable in many cases, unless the Poorman, a new native variety of large size, proves widely adapted.

Figure 26 shows fruits of the Columbus, Industry, May Duke, Poorman, Downing, and Carrie varieties.

AMERICAN VARIETIES.

Carrie.—Fruit small to medium, too small to be promising, red when ripe. Bush quite free from mildew, with few short thorns; very productive. Grown chiefly in Minnesota, Wisconsin, and neighboring States, where it is of value. When grown in the Eastern States it greatly resembles the Houghton, but it is not recommended to replace that variety.

Downing.—Fruit large for an American sort; pale green. Bush rarely attacked by mildew; very productive. The most widely grown variety in the United States and liked better than other varieties for canning. Notably resistant to the aphis.

Houghton.—Fruit small, dark red. Bush more susceptible to mildew than the Downing, branches somewhat drooping; very productive. One of the most widely grown and productive varieties in the United States, but too small and not liked as well for canning as the Downing. Very susceptible to the aphis.

Josselyn (*Red Jacket*).—Fruit large for an American sort; reddish green. Bush productive; mildews in some localities; a promising variety in some localities in the Northeastern States.

Oregon (*Oregon Champion*).—Fruit large for an American sort; color green; season late. Bush very productive; rarely attacked by mildew. The best variety in the Northwestern Rocky Mountain and Pacific Coast States and promising for all parts of the United States.

Poorman.—Fruit the largest of the American varieties, brilliant red when mature. Bush very vigorous, productive; thorns shorter and fewer and less objectionable than those of other varieties. In New York and Utah it is considered the best of all varieties. Promising for all parts of the United States.

EUROPEAN VARIETIES.

Chautauqua, Columbus, Portage, and Triumph.—These varieties are all very similar, even if not identical. Fruit very large; pale green. Bush in open localities does not mildew seriously; somewhat spreading; productive. Replacing American varieties to some extent because of their larger fruit; generally liked better than the Industry variety.

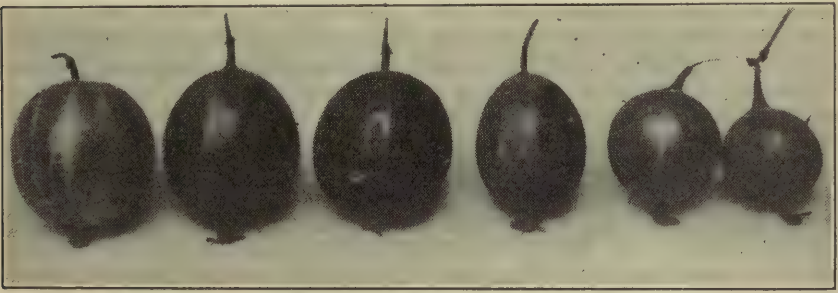

FIG. 26.—Gooseberries of different varieties, showing the relative sizes of the fruits. From left to right the individual fruits represent the Columbus, Industry, and May Duke (European sorts), and the Poorman, Downing, and Carrie (American sorts).

Industry.—Fruit very large, dark red, somewhat hairy. Bush upright; productive. Bush and fruit subject to mildew. Nursery stock of this variety should be secured in the bush rather than the tree form.

Runge.[1]—A European variety quite similar to the Columbus. In the Hudson River Valley, where large quantities of it are grown, it appears somewhat more productive and less susceptible to mildew and the berries ripen somewhat later than that variety.

May Duke.—Fruit large, dark red; season early. Bush spreading, productive. This variety is recommended by the New York Agricultural Experiment Station as the best early gooseberry of European parentage.

WAYS OF USING THE FRUIT.

Currants and gooseberries are used chiefly in making jams, jellies, preserves, pies, tarts, etc., rather than in the fresh state, like most other fruits. Both fruits contain a large amount of pectin, which is necessary for jelly making. The currant is commonly considered the best of all fruits for making jelly, but comparatively few know that gooseberry jelly is very nearly, if not quite, as good as currant jelly and may be made much more cheaply. Furthermore, gooseberries are a general favorite for jam, and gooseberry-raspberry or gooseberry-raspberry-currant jams are better even than jam made of gooseberries alone. In fact, both the currant and the gooseberry may be used in many different ways and are especially valuable for combining with other fruits. Directions for the utilization of the fruit are given in the following pages. The following points should be especially noted:

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[1] This variety was introduced and distributed by Mr. J. H. Runge as "Large White German," though the name by which it is designated in Europe is unknown; but in accordance with the rules of nomenclature of the American Pomological Society, it is listed here as Runge, with the consent of the introducer.

(1) The seeds of the red and the white currants become very noticeable upon cooking and should be removed when making jams, preserves, etc. Black-currant seeds and gooseberry seeds usually do not become objectionable when cooked and may be left in.

(2) If cooked slowly those gooseberries which are green in color when ripe will make jam or jelly as highly colored as those which are red when fully ripe.

(3) The flavor, texture, and color of gooseberry jam and jelly made by long cooking are quite different from those made by rapid boiling. Part of the flavor of the fresh fruit is lost through long cooking; the color is deepened and the texture is slightly toughened. Some like the product made by cooking a few minutes much better than that made by cooking for an hour or more; others prefer the slowly cooked product.

(4) If a fruit pulp machine similar to a food grinder is used, the skins and seeds of the currant may be readily separated from the pulp. This pulp can then be used for jam and the skins for making jelly. The jam resulting from the use of the pulp only is preferred by many to that containing both skins and pulp.

(5) The pulp from which the juice has been pressed for jelly may be reheated with water and pressed a second time. The resulting juice makes a very good grade of jelly. In many cases a third or even a fourth extraction of the juice may be made.

(6) In making jams and jellies the proportion of sugar to berries will vary according to individual taste and the character of the fruit. Jams of good flavor may be made by the use of 1 pound of sugar to 1 pound of unripe berries or one-half to three-fourths of a pound of sugar to 1 pound of ripe berries. In making jelly 1 pound of sugar to 1 pint of juice of unripe fruit or three-fourths of a pound of sugar to 1 pint of juice of ripe berries may be used.

(7) Black currants belong to two groups—the European and the American. Although varieties of both sorts have the peculiar aroma of black currants, the American black currant loses most of this characteristic flavor after cooking and makes a mild, delicately flavored product, while varieties derived from the European species make a strong-flavored jam or jelly. It is well to combine these different extractions before making them into jelly; otherwise, the later extractions may be somewhat lacking in flavor.

JELLIES.

Jelly of the best quality is easily made from either currants or gooseberries. Although currant jelly has been generally considered the better, some prefer that made from gooseberries. The finest colored product is made from one part of white currants to four parts of red currants.

For use in jelly making the currants and gooseberries should be picked before they are entirely ripe. The fruit should be washed, but need not be stemmed. After mashing add a small quantity of water, heat almost but not quite to the boiling point, and hold there until the skins turn a lighter color; then strain through a jelly bag. Add three-fourths of a pound of sugar to each pint of juice and boil until a small quantity, when poured from a spoon, flows in a sheet rather than in single drops. Pour into sterilized glasses and, when cool, seal with hot paraffin.

By following these simple directions excellent jellies can be made. In making especially delicate jellies the following precautions should be observed: Remove the stems before cooking. Use only dry berries, and do not use those picked within two days after a rain. That juice is best which flows from the jelly bag without pressing, but the juice which is pressed out may be used for second-grade jelly. Boil the juice separately for 10 minutes and heat the sugar before combining the two. In order to get a deep-red gooseberry jelly the juice should be boiled down slowly. To secure pink gooseberry jelly the juices should be boiled down quickly. Tart jellies may be made by using one-half pound of sugar to each pint of juice, and sweet jellies by using 1 pound of sugar to each pint of juice.

JAMS.

The seeds of red and of white currants are large and very objectionable, so that jams are rarely made from them unless the seeds are first extracted. Even then, the jam is not usually liked as well as gooseberry jam or such combinations as gooseberry-currant or raspberry-currant jams. For use with bread, crackers, etc., raspberry-currant jam is considered one of the most desirable, and then, in order of merit, gooseberry-currant, gooseberry, and currant jams.

For use with meats, gooseberry, gooseberry-currant, and gooseberry-blackberry combinations are all liked. Strawberries, raspberries, apples, cherries, etc., may also be combined with currants and gooseberries, and jams thus made will add a pleasing variety to the supply of preserves.

Black-currant jams have a peculiar flavor, and it is usually necessary for Americans to acquire a taste for them before they are very well liked. Varieties of European parentage are considered better for making jam and jelly than those of American parentage, for the latter lose the distinctive black-currant flavor in cooking.

Gooseberry jam.—Wash, "top and tail" (i. e., remove the stems and the remains of the blossoms), mash, and boil until soft. Add a little water and one-half to three-fourths of a pound of sugar to a pint of gooseberry pulp. Boil rapidly to make a light-colored jam or slowly to make a deep-red jam. When of the desired thickness pour into sterilized jars and seal. By the use of a fruit pulp machine, similar to a food grinder, the skins and seeds may be removed from the gooseberry pulp either before cooking or after the gooseberries have been softened by cooking a short time. This will make "topping and tailing" unnecessary, but the resulting jam is less palatable to some.

Currant jam.—Currant jam is made in the same manner as gooseberry jam. The seeds, however, should be removed with the pulp machine mentioned above or the fruit should be pressed through a colander.

Gooseberry-currant jam.—Very good combinations may be made by using one-half each of gooseberries and currants or a larger or smaller quantity of either, according to the supply. The currant seeds should, of course, be removed. Otherwise, the jam is made according to the directions for gooseberry jam.

Gooseberry-blackberry jam.—In making the combination of gooseberries and blackberries for jam, equal quantities of each fruit or two-thirds blackberries and one-third gooseberries may be used. The blackberries should be mashed, added to the mashed gooseberries, and the jam made according to the directions for gooseberry jam.

Raspberry-currant jam.—Equal quantities of raspberries and currants are used for raspberry-currant jam. Extract the currant seeds before cooking and proceed as above.

Black-currant jam.—This jam should be made according to the directions for making gooseberry jam except that it will be necessary to add considerable water before cooking. It is sometimes recommended that rhubarb be added in the proportion of one part of rhubarb to four parts of currants.

UNFERMENTED JUICES.

While unfermented juices made from gooseberries and currants are not generally used, they are desirable for home purposes. They can be used either separately or combined with each other or with the juices of other fruits.

Use sound, clean, ripe currants and unripe gooseberries. Extract the juice as for jelly making. Strain through a flannel cloth and place in bottles or fruit jars. Put the jars or bottles in a water bath and heat the juice almost to the boiling point, but do not boil. A temperature of 180° F. is desirable. Hold the juice at this temperature for 30 minutes; then remove from the water and seal. The juice should be stored in the coolest place available, as unless made with black currants it gradually loses its color and flavor if kept at living-room temperatures.

Preparation for use.—Some sugar should be added to the juice before bottling or the juice should be reheated and sweetened before using, as juice without sugar or juice to which sugar has been added while cold usually has an unpleasant aroma. Water should be added before using, as the juice is entirely too acid to be used undiluted.

OTHER PRODUCTS.

Currants and gooseberries are used for making conserves, preserves, pastes, marmalades, spiced products, catsups, and for canning. Gooseberry tarts and pies made of green gooseberries or green currants are especially popular.

LAWS AFFECTING CURRANTS AND GOOSEBERRIES.[1]

Synopsis of Laws and Quarantine Regulations of the Various States and of the United States and Canada Bearing on the Control of the White-Pine Blister Rust, which Affects the Shipment, Planting, and Propagation of Currants, Gooseberries, and Five-Needled Pines.

Connecticut.—The law authorizes the proper State authorities to enter upon any public or private property in the performance of their duties; to uproot and destroy all currant and gooseberry bushes infected with the blister rust; to designate districts within which all currant and gooseberry bushes growing wild, abandoned, or escaped from cultivation may be uprooted and destroyed;[2] and to maintain quarantines against other States or any designated area within the State.

Maine.—Authority is granted the State forest commissioner to designate control areas within which landowners may be required to remove all currant and gooseberry bushes. If they fail to do so, he may cause such plants to be destroyed. He or his authorized agents are empowered to enter upon any public or private property and to destroy all infected and all wild currant and gooseberry bushes in any part of the State. In any designated area he may destroy by specific order any undiseased currant or gooseberry bushes or white pines. He is also authorized to prohibit or regulate the entry into and movement within the State of any living 5-leaved pines, or any currant and gooseberry plants, or other nursery stock or plants which may introduce or spread a dangerous plant disease or insect. The State nursery inspector is empowered to use the above measures in controlling the blister rust on land in the vicinity of nurseries.

Massachusetts.—The law provides for the destruction of all currant and gooseberry bushes which are infected with the blister rust or liable to become infected and gives authority to enter upon any public or private property. This power is vested in the State nursery inspector and his deputies.

New Hampshire.—The State forester is empowered to designate control areas and all landowners within such areas may be required to destroy all currant and gooseberry bushes, and within such areas no person shall plant any currant or gooseberry bush without the permission of the State forester. He or his agents have the right to enter upon any public or private property in the performance of their duties. Any currant or gooseberry bushes infected with blister rust are declared a public pest, and any such diseased plants, together with all wild currant and gooseberry bushes, may be destroyed by order of the State forester or his agents. The State nursery inspector is given the above power for the control of blister rust in the vicinity of nurseries and is empowered to prohibit or regulate the entry into and movement within the State of any 5-leaved pine trees or any plants of the genus Ribes or other nursery stock or plants which may introduce or spread a dangerous insect pest or plant disease.

New York.—The black currant (including *Ribes nigrum*, *R. odoratum*, and *R. aureum*) is declared a public nuisance and its growth within the State prohibited, except undiseased *Ribes nigrum* in "fruiting-currant districts." Within such designated districts all diseased bushes may be destroyed and all 5-needled pines may be cut down and the growing of them be prohibited. Outside "fruiting-currant districts" any wild or cultivated currants or gooseberries may be destroyed except within annually certified nurseries. The conservation commission may establish quarantine districts within the State and therein may prohibit the possession of any currant or gooseberry bushes, but this shall not apply to undiseased cultivated bushes in "fruiting-currant districts." It may also prohibit the transportation to and from quarantine districts of currant or gooseberry plants.

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[1] Compiled by J. F. Martin and Roy G. Pierce, forest pathologists, Office of Forest Pathology, Bureau of Plant Industry.

[2] Local control area in which currant or gooseberry bushes growing wild, abandoned, or escaped from cultivation may be uprooted or destroyed: Litchfield County—the towns of Canaan, Colebrook, Norfolk, and North Canaan.

Pennsylvania.—The secretary of agriculture, through the State nursery inspector or his deputies, may enter upon and inspect any public or private property which might become infested or infected with dangerous or harmful insects or plant diseases. The secretary of agriculture is empowered to prescribe, modify, and enforce such reasonable rules, regulations, and orders as may be needed to enforce the law; also to prohibit and prevent the removal, shipment, or transportation of nursery stock or any other article capable of carrying any injurious or harmful insect pest or plant disease for such periods and under such conditions as in his judgment seems necessary in order to prevent further spread of the infestation or infection. Trees, plants, shrubs, or other plant material infested or infected with injurious insects or plant diseases shall be deemed a public nuisance. It is unlawful for any person in the State knowingly to permit any destructive or dangerously harmful insect or plant disease to exist in or on his premises.

Rhode Island.—Blister rust is declared a public nuisance, and its suppression is authorized. The State board of agriculture may make such rules governing the suppression or extermination of this disease, including the destruction of diseased or exposed species of currants and gooseberries, as it may deem necessary and may enter upon public or private property in the performance of their duties. The board of agriculture may make such regulations governing the transportation of currants and gooseberries as it may deem necessary in combating the disease.

Vermont.—The commissioner of agriculture may use such means as is deemed necessary to exterminate or prevent the introduction of threatening or unusual fungous diseases. He may designate and take control of certain areas to prevent the spread of a plant disease and within such areas may destroy the host of any plant disease. He or his agents may enter upon public or private land in the performance of their duties.

SUMMARY OF STATE AND FEDERAL QUARANTINE REGULATIONS IN EFFECT ON OR BEFORE JANUARY 1, 1919.

State.	Plants quarantined against—		Quarantined area.
	Currants and gooseberries.	White and other 5-needled pines.	
California	All kinds	All kinds	East of the Mississippi River.
Delaware	do	do	Shipments prohibited into the State, within the State, or out of the State.
Georgia	do	do	All points outside the State.
Idaho	do	do	All points east of and including Minnesota, Iowa, Missouri, Arkansas, and Louisiana.
Illinois	do	do	All New England States, New York, Pennsylvania, New Jersey, Ohio, Wisconsin, and Minnesota, except that currants and gooseberries may be imported under special permit from Illinois department of agriculture. Shipments from all other sources are also denied entry unless accompanied by a statement showing that the plants were propagated and entirely grown in localities not included in the above States, in Canada, or in Europe or Asia.
Indiana	None	do	All points outside the State.
Kansas	All kinds	do	All points east of and including Minnesota, Iowa, Missouri, Arkansas, and Louisiana.

SUMMARY OF STATE AND FEDERAL QUARANTINE REGULATIONS, ETC.—Continued.

State.	Plants quarantined against—		Quarantined area.
	Currants and gooseberries.	White and other 5-needled pines.	
Maine	All kinds	None	All points outside the State, except by permit from State forest commissioner.
Do	do	do	Local control areas within which the growing of gooseberries and currants is prohibited: York County—towns of Alfred and Kittery; Cumberland County—town of Brunswick.
Maryland	do	All kinds	All New England States, New York, New Jersey, Pennsylvania, Wisconsin, Minnesota, Michigan, and Illinois.
Massachusetts	do	None	All points outside the State except under permit from the commissioner of agriculture.
Michigan	do	All kinds	All points outside the State, with a proviso permitting the shipment of currants and gooseberries into the State under permit from the State nursery inspector.
Minnesota	do	do	All New England States, New York, New Jersey, Pennsylvania, Ohio, Michigan, and Wisconsin.
Montana	do	do	All points east of and including Minnesota, Iowa, Missouri, Arkansas, and Louisiana
Nevada	do	do	East of the Mississippi River and Minnesota; all foreign countries.
New Hamphsire	do	do	All points outside the State. The shipment of all currants and gooseberries within the State is also prohibited.
Do	do	do	Local control areas within which currants and gooseberries may not be planted without the permission of the State forester.[1]
New Jersey	None	do	All New England States, New York, Pennsylvania, Michigan, Wisconsin, and Minnesota.
New York	do	do	All New England States, New Jersey, Pennsylvania, Ohio, Illinois, Indiana, Wisconsin, and Minnesota.
Do	All kinds	None	Local control areas in New York (for the growing of white pine) within which no Ribes may be grown or into which no Ribes may be shipped.[2]
North Carolina	do	All kinds	All New England States, New York, New Jersey, Pennsylvania, Ohio, Michigan, Wisconsin, Minnesota, and Canada.
Oregon	do	do	East of the Mississippi River; all foreign countries.
Pennsylvania	None	do	All points outside the State.
Rhode Island	All kinds	do	A permit from the State board of agriculture is necessary before white pines or gooseberries and currants can be planted in the State; no planting of 5-leaved pines or plants of the genus Ribes is permitted in the towns of Coventry and West Greenwich; the planting of black currants and flowering currants is prohibited within the State.
South Carolina	do	do	All points outside the State.
South Dakota	do	do	All New England States, New York, New Jersey, Pennsylvania, Ohio, Wisconsin, and Minnesota.
Tennessee	do	do	All points outside the State.
Vermont	None	do	Do.
Washington	All kinds	do	All points outside the State except Oregon.
West Virginia	do	do	All points outside the State.
Wisconsin	None	White pines	All New England States, New York, and Minnesota.

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[1] These control areas in New Hampshire at present comprise parts of the following towns: Belknap County—Meredith and Tilton; Carroll County—Bartlett, Conway, Ossipee, Tamworth, and Wolfboro; Cheshire County—Dublin, Fitzwilliam, and Swanzey; Grafton County—Bethlehem, Franconia, Hanover, Landaff, Lisbon, Littleton, Orford, and Piermont; Hillsborough County—Amherst, Milford, Peterboro, and Wilton; Rockingham County—Brentwood, Exeter, Hampton, Newfields, and Stratham; Strafford County—Dover, Durham, Farmington, Newmarket, and Rollinsford.

[2] These local control areas in New York are as follows: Clinton County—towns of Au Sable, Black Brook, and Peru; all of Columbia County except the towns of Greenport, Kinderhook, Livingston, Stockport, Stuyvesant, Germantown, and Clermont; all of Essex County; Niagara County—towns of Porter, Lewiston, and Niagara; Rensselaer County—towns of Berlin, Petersburg, and Stephentown; all of Warren County; all of the Adirondack Park and Catskill Park, as defined in chapter 451, laws of 1916.

SUMMARY OF STATE AND FEDERAL QUARANTINE REGULATIONS, ETC.—Continued.

State.	Plants quarantined against—		Quarantined area.
	Currants and gooseberries.	White and other 5-needled pines.	
Canada	All kinds	All kinds	All foreign countries, except that currants and gooseberries may be imported from the United States west of and excluding the States of Minnesota, Iowa, Missouri, Arkansas, and Louisiana.
United States	do	do	Europe, Asia, Canada, and Newfoundland.
Do	do	do	All points east of and including Minnesota, Iowa, Missouri, Arkansas, and Louisiana.
Do	All black currants.	do	All New England States and New York.

PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE OF INTEREST IN CONNECTION WITH THIS BULLETIN.

AVAILABLE FOR FREE DISTRIBUTION BY THE DEPARTMENT.

Blackberry Culture. (Farmers' Bulletin 643.)
Dewberry Culture. (Farmers' Bulletin 728.)
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Strawberry Culture in Tennessee, Kentucky, and West Virginia. (Farmers' Bulletin 854.)
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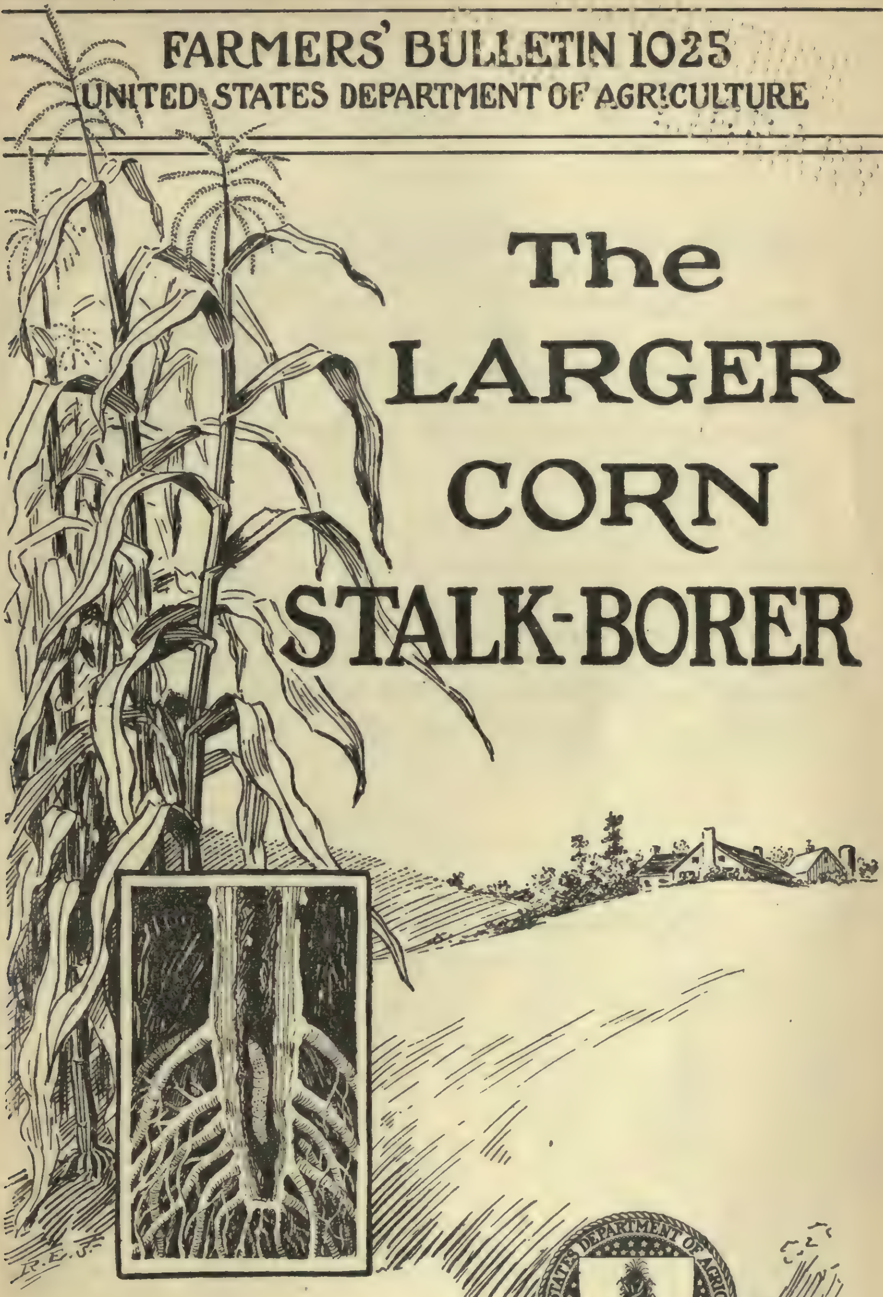
Raspberry Culture. (Farmers' Bulletin 887.)
Everbearing Strawberries. (Farmers' Bulletin 901.)
Commercial Evaporation and Drying of Fruits. (Farmers' Bulletin 903.)
Information for Fruit Growers about Insecticides, Spraying Apparatus, and Important Insect Pests. (Farmers' Bulletin 908.)
Preparation of Strawberries for Market. (Farmers' Bulletin 979.)
Farm and Home Drying of Fruits and Vegetables. (Farmers' Bulletin 984.)
Culture of the Logan Blackberry Related Varieties. (Farmers' Bulletin 998.)
Growing Fruit for Home Use. (Farmers' Bulletin 1001.)
Strawberry Culture: South Atlantic and Gulf Coast Regions. (Farmers' Bulletin 1026.)
Strawberry Culture: Western United States. (Farmers' Bulletin 1027.) In press.
Strawberry Culture: Eastern United States. (Farmers' Bulletin 1028.) In press.
Strawberry Varieties in the United States. (Farmers' Bulletin 1043.)
Strawberry Supply and Distribution in 1914. (Department Bulletin 237.)
Factors Governing the Successful Shipment of Red Raspberries from the Puyallup Valley. (Department Bulletin 274.)
Directions for Blueberry Culture, 1916. (Department Bulletin 334.)
Marketing and Distribution of Strawberries in 1915. (Department Bulletin 477.)
Rhizopus Rot of Strawberries in Transit. (Department Bulletin 531.)
Further Studies of the Rots of Strawberry Fruits. (Department Bulletin 686.)
Marketing Berries and Cherries by Parcel Post. (Department Bulletin 688.)
Factors in Transportation of Strawberries from the Ozark Region. (Bureau of Markets Document 8.)

FOR SALE BY THE SUPERINTENDENT OF DOCUMENTS, GOVERNMENT PRINTING OFFICE, WASHINGTON, D. C.

Possibilities and Need of Supplemental Irrigation in the Humid Region. (Yearbook Separate 570.) Price, 5 cents.
The Strawberry Weevil. (Bureau of Entomology Circular 21.) Price, 5 cents.
The Common Red Spider. (Bureau of Entomology Circular 104.) Price, 5 cents.

FARMERS' BULLETIN 1025
UNITED STATES DEPARTMENT OF AGRICULTURE

The LARGER CORN STALK-BORER



MANY a fine field of corn in the South Atlantic States is broken off by heavy winds during the later growing season. Examination will show that the stalks had been weakened by insects boring into them. The damage was done by a pale, dark-spotted caterpillar, the larger corn stalk-borer.

Only corn is injured seriously by this insect; some of the larger grasses are food plants, and sugar cane sometimes is damaged slightly.

This bulletin gives the life history of the insect, its feeding habits, and methods of combating it. There are two generations in a season, so greater vigilance is necessary.

The second generation passes the winter only in the corn roots, so if these are destroyed or plowed under deeply, the pest will be largely decreased. The injury is worst where corn follows corn, so rotation of crops will help to destroy the pest.

Contribution from the Bureau of Entomology,

L. O. HOWARD, Chief.

Washington, D. C. February, 1919.

THE LARGER CORN STALK-BORER.[1]

GEORGE G. AINSLIE,
Entomological Assistant, Cereal and Forage Insect Investigations.

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BROKEN STALKS AND BORER WORK.

IN MANY southern cornfields a heavy wind late in the season, before the corn is matured, does great damage by breaking the plants off at the surface of the ground. Usually these broken stems have been weakened by the burrows of a larva or caterpillar (fig. 1) known as the larger corn stalk-borer. Its work is largely within the stem of the plant and is so concealed that, in most cases, unless weather conditions make it conspicuous, the presence of the insect passes unnoticed.

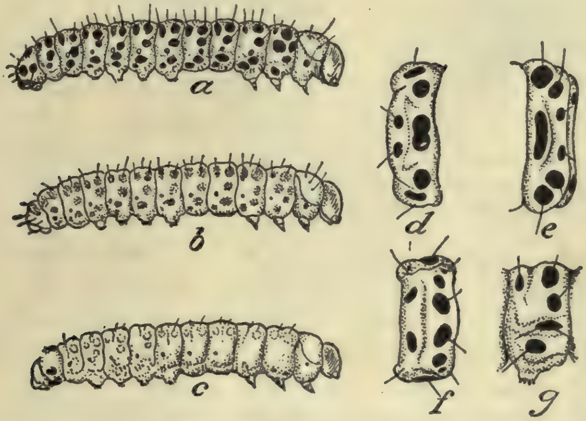

FIG. 1.—The larger corn stalk-borer: *a*, Summer form of larva; *b*, *c*, hibernating forms of larvæ; *d*, third thoracic segment from above; *e*, eighth abdominal segment from above; *f*, abdominal segment from above; *g*, same from side. *a*, *b*, *c*, Enlarged; *d*, *e*, *f*, still more enlarged. (Redrawn from Howard.)

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[1] *Diatraea zeacolella* Dyar.

NOTE.—This publication supersedes Farmers' Bulletin 634.

WHERE THE BORER IS FOUND.

This insect is very similar to the borer[1] of sugar cane occurring in the southern parts of Louisiana, Florida, and Texas, and in the Tropics, and for a long time was supposed to be the same. As it has proved to be distinct, it is probable that it is a native of the Atlantic States from northern Florida to Maryland, where it is now found. Even in the southern part of this region, where cane is grown, the insect rarely attacks it, although the closely related sugar-cane borer feeds on corn and sugar cane indiscriminately.

This corn borer is known to occur throughout the Atlantic States east of the Appalachians from Florida to Maryland and as far west as Alabama (fig. 2). What appears from its method of work to be the same insect has been reported from Arizona and New Mexico and north to Kansas. The exact western limits of its occurrence are unknown.

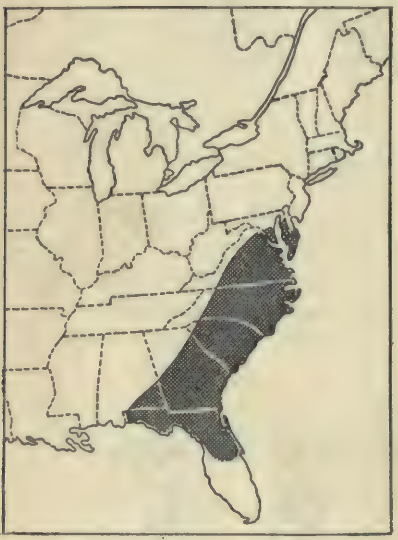

FIG. 2.—Map showing present known distribution of the larger corn stalk-borer.

EXTENT OF ITS DAMAGE.

It has been reported most frequently as injurious to corn in Georgia, South Carolina, North Carolina, and Virginia, but in 1898 many cornfields in the southern and eastern part of Maryland practically were abandoned because of its attacks. In 1909, at Waynesboro, Ga., cornfields were "at least one-third destroyed" by it and in October of the same year one-half of the cornstalks at Diamond Springs, Va., were infested, often with several larvæ each. At Clemson College, S. C., in 1909 and 1910, a majority of the plants in most fields were infested and several cases were observed where hundreds of stalks were broken and ruined by windstorms when the corn was about mature. In most cases it is the earlier planted corn that suffers most severely from the work of the larvæ in the bud.

NATURE OF THE DAMAGE.

These caterpillars damage corn in two ways. First, in the early part of the season, while the plants are small, they work in the "throat" of the young corn and, if the tender growing tip within the protecting leaves is once damaged, all chance that the plant will become a normal productive specimen is gone. In many sections this is commonly known as "budworm" injury, and while several other insects cause a similar mutilation of the leaf, a considerable proportion of the so-called "budworm" damage in many localities should be laid to this insect. Its work on the small plant appears later on the unfolded leaves as rows of small round or oval holes in straight lines across the leaves (fig. 3), very similar to those caused by the corn billbugs.

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[1] *Diatraea saccharalis crambidoides* Fabricius.

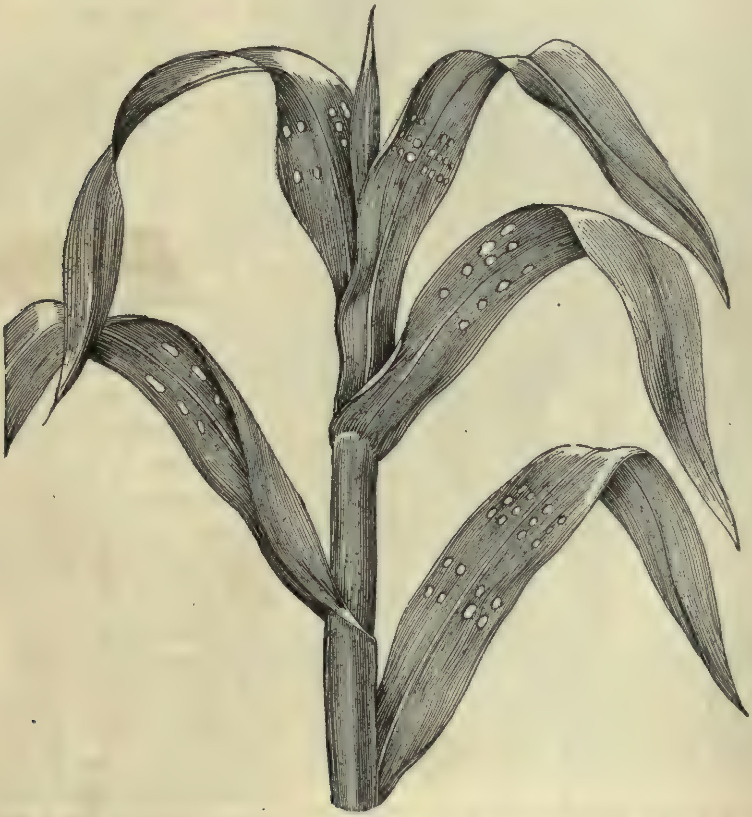

FIG. 3.—Work of the larger corn stalk-borer showing damage to the leaves caused by the larvæ of the first generation.

The more conspicuous and usually much the more serious form of injury chargeable to this pest, however, occurs later in the season. The larvæ, having left the leaves and descended to the lower part of the stalk, tunnel in the pith (figs. 4, 5). If they are at all numerous, their burrows so weaken the stalk that any unusual strain will lay it low and destroy all chance of its maturing. While many larvæ may live and work in one plant, it must be remembered that any infestation, however light, will weaken in some degree the vitality of the plant and cause a corresponding loss in the quality and quantity of the harvest.

DESCRIPTIONS OF THE DIFFERENT FORMS OR STAGES OF THE INSECT.

The four successive stages in the development of this insect are (1) the egg, (2) the larva, caterpillar, or borer, (3) the pupa, chrysalis, or resting stage, and (4) the adult or moth.

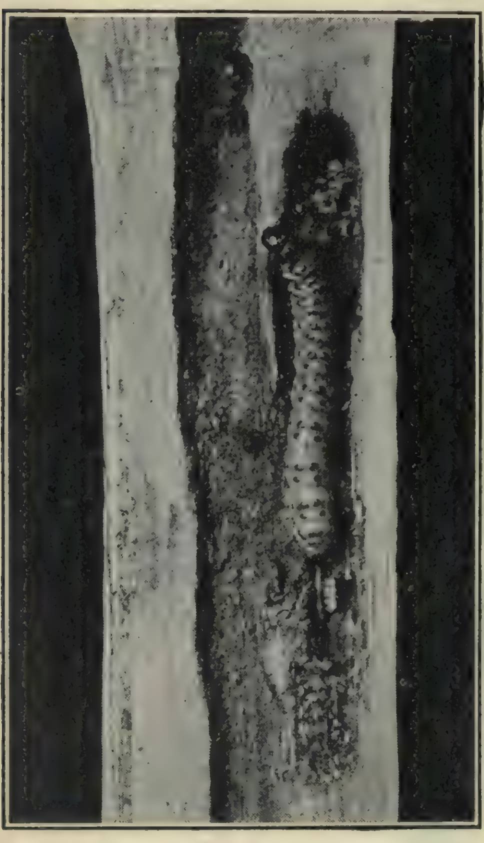

FIG. 4.—Work of the larva of the larger corn stalk-borer in cornstalk. Enlarged.

THE EGG.

The eggs (fig. 6) are flat and scalelike, almost circular in outline, and are placed in rows or irregularly, overlapping one another shingle fashion. From 2 to 25 eggs are laid in one place on the underside of a lower leaf, or occasionally on the upper side or on the stem. Creamy white when first laid, they change gradually to reddish brown and, in from 7 to 10 days, a minute, bristly, reddish caterpillar cuts a hole in the shell and crawls out through a narrow slit at one end. The eggs are about three one-hundredths of an inch (7.6 mm.) long and two-thirds as wide. After hatching, the white papery eggshells are soon washed off the leaves.

THE LARVA.

The larva of the first generation (fig. 1, *a*) when full grown is a robust, dirty-white caterpillar 1 inch in length, thickly covered with round or irregular dark spots, each of which bears a short, dark bristle. When the larva is small these markings almost touch one another, giving the whole insect a dark color and a hairy appearance. The head and the neck shield of all the stages are brownish yellow. The overwintering larva of the second generation (fig. 1, *b*, *c*) gradually loses the darker markings of the body and after the last molt remains unspotted and light yellow, except for the head and the neck shield, which retain the brownish yellow color of the earlier stages.

THE PUPA.

When first formed, the pupa (fig. 7) is light honey-yellow in color, soon changing to a rich mahogany brown. It is about seven-eighths of an inch in length and contorts itself violently when disturbed. It lies in the cavity, usually with the head up. On emerging, the moth leaves the brownish shell of the pupal case partially withdrawn from the hole.

THE ADULT OR MOTH.

The female moth (fig. 8) varies from almost white to smoky yellow. The fore wings, which spread to about 1¼ inches, are darker than the hind wings, and bear faint markings. When at rest the wings are held close to the body, forming an acute triangle. Egg-laying occurs, for the most part, either at night or in the dusk of evening, the moths flying rapidly from plant to plant. The male moth usually is somewhat darker than the female and always smaller. The moths of both sexes occasionally appear at lights, but during the day they remain hidden in the "throat" of the corn plant, beneath the leaves or in some other sheltered place.

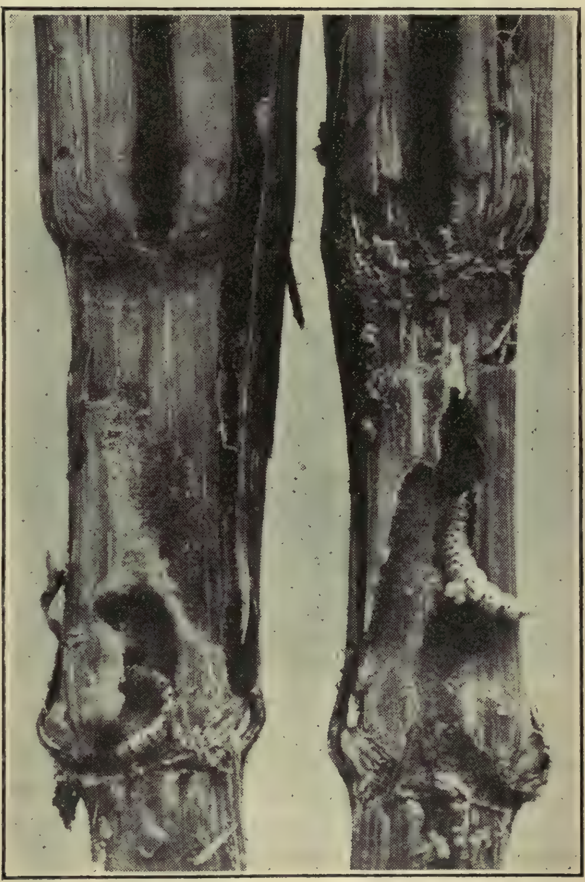

FIG. 5.—Work of the larvæ of second generation of the larger corn stalk-borer in old stalks. About natural size.

HABITS OF THE LARVAE OR BORERS.

Immediately upon leaving the egg in the spring each young larva of the first generation, spinning a silken thread behind it, goes down into the "throat" of the plant as far as the water or dew usually standing there will allow, and begins to feed on the leaves, going back and forth through the yet unfolded clusters, and soon riddles the more tender leaves with aimless burrows. If the burrow reaches the tender terminal bud where the future joints are being formed, further growth at that point ceases, and the plant becomes stunted and misshapen, with no tassel. As the plant continues to mature, the larva "grows out," as the farmers say. Probably it is not the larva itself that "grows out" but the evidence of its work. The caterpillar soon forsakes the more leafy portion of the plant and attacks the stalk at or near the ground. Here a hole is cut through the outer wall of the stalk and the larva burrows upward for a short distance, after which it seems to run aimlessly through the pith, often even leaving the stalk and reentering it at another point. Turning upward, the caterpillar, when fully grown, bores toward the outside and cuts a circular hole in the outer wall of the stalk. Then, after spinning a few loose threads across the opening to keep out undesirable visitors, it retreats a short distance, plugs the burrow below with digested pith, and in the chamber thus formed slowly changes to the next stage, the resting stage or pupa (fig. 7).

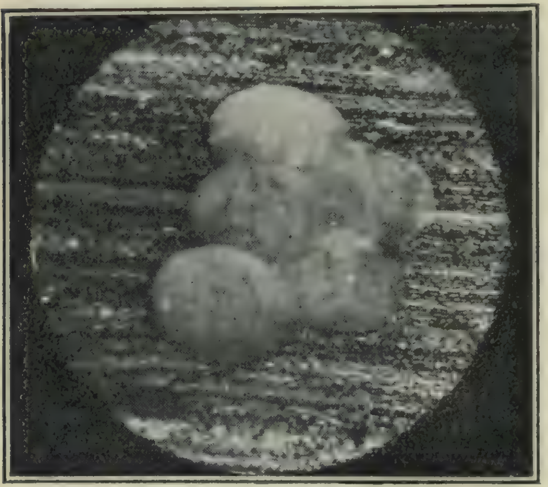
FIG. 6.—Eggs of the larger corn stalk-borer. Highly magnified.

Seldom is the stalk damaged above the third joint from the ground although the larvæ, when small, are found in the large midribs of the lower leaves and later in the season, when the food supply is restricted, even in succulent "nubbins" farther up. Sometimes they penetrate the underground part of the stalk in feeding and enter some of the larger brace-roots for a short distance.

The larvæ of the second generation work in a similar manner, except that at the time they appear the tassel has been formed; hence the damage is now confined altogether to the lower stalk. Thus, instead of arranging to pass the pupal period in the stalk above ground, they penetrate to the root and there, as larvæ, pass the winter in a dormant state (see title page).

LIFE OF THE INSECT THROUGHOUT THE YEAR.

During the winter this enemy of the corn plant is found as a robust creamy-white larva of the second generation in the lower part of the stalk, or, if the corn has been cut, in the stubble. Here the larva forms a small cavity below the surface of the ground, well protected from birds, predatory insects, and unfavorable weather conditions. From the time the corn is mature in the fall until about corn-planting time in the spring this caterpillar remains inactive. About the time the ground is being prepared for corn, from March 15 to April 30, depending on the locality, this larva changes into a reddish-brown pupa or chrysalis. After ten or more days in this stage the adult insect emerges from the pupal case as a pale yellowish-brown moth (fig. 8) with wings which spread about 1¼ inches. The moths mate and the females begin to deposit eggs on the underside of the leaves. The larvæ hatching from these eggs form the first generation of the season.

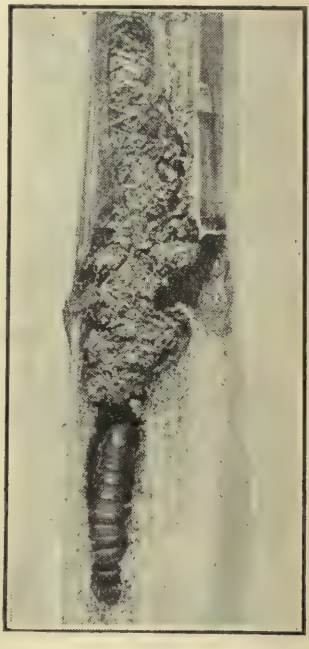

FIG. 7.—Pupa of first generation of the larger corn stalk-borer in injured stalk of corn. About natural size.

The eggs hatch in from 7 to 10 days, and the larvæ begin their destructive work in the upper leafy portion of the plant, later descending to the base of the stalk, where they attain full growth. This period, from egg to full-grown larva, requires from 20 to 30 days, depending largely on the weather conditions and the vigor of the plant. The larvæ when full-grown pupate in the stalk, usually in the second or third joint from the ground, and in from 7 to 10 days the adult moths of the first generation emerge.

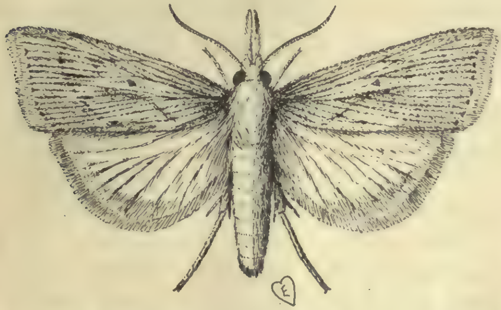

FIG. 8.—Moth or parent of the larger corn stalk-borer. Twice natural size.

The eggs for the second generation are laid in similar positions on the lower leaves or on the stem, and the larvæ, after feeding for a short time on the leaves, go directly to work in the stalk, completing their larval growth in the pith of the lower stalk as did the larvæ of the first generation. No damage is done to the upper part of the plant by these larvæ of the second generation. By the time they are fullgrown, the corn is rapidly nearing maturity and, instead of pupating in the stalk, they work downward, penetrate to the extreme lower tip of the taproot below ground, and there form a small cavity in which to pass the winter. At this time the larvæ lose the darker markings of the earlier forms and, as overwintering larvæ, are creamy yellow in color. They are plump and active in the fall, but flabby and sluggish after fasting throughout the winter. The only way in which the insect passes the winter is in the form of this overwintering larva, found below the ground in the extreme lower tip of the corn roots. There is no evidence that there are ever more than two generations a year.

As many as a dozen larvæ are sometimes found in one stalk, but seldom do more than two or three of these reach the pupa stage. In the winter there is usually only a single larva in a root, although occasionally two are found, always in separate cavities.

OTHER PLANTS ON WHICH IT FEEDS.

Besides corn this borer has been reported as feeding on sorghum, Johnson grass, guinea corn, grama grass, and rarely on sugar cane. The injury to plants other than corn is never severe but, in planning methods of control, these plants must be considered and an examination made to determine whether or not they are harboring the pest.

NATURAL CHECKS TO ITS INCREASE.

The larger corn stalk-borer has very few natural enemies. A minute wasplike parasite [1] has been found in a few instances living in and destroying the eggs. In one case 10 of these parasites were reared from 2 eggs. The brown, velvety larva of a beetle [2] has been found entering the burrows after the corn has been cut and devouring the larvæ. Termites [3] or white ants, locally known as wood lice, have been observed destroying the larvæ in the stubble in winter, although apparently only when the presence of the larvæ interfered with their work. In a few cases bodies of the borers have been found in the stubble killed by a fungus, as yet undetermined, which envelops their bodies in a white mold. Fungi, however, are too dependent on weather conditions to be of any practical value in controlling the pest.

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[1] *Trichogramma pretiosa* Riley.

[2] *Chauliognathus pennsylvanicus* De Geer.

[3] *Leucotermes* spp.

HOW TO PREVENT DAMAGE.

Rotation is one of the best general preventives of injury from insects affecting field crops. Experience has shown that where corn has followed itself upon the same field for two or more years, the loss from the borer has been much greater than where an annual change has been practiced. This is especially noticeable where stalks or stubble from the previous year have been allowed to remain undisturbed throughout the winter. Upon emerging in the spring, the moths, finding themselves surrounded by young corn, commence egg laying at once, and escape the dangers encountered in searching for another field of corn. A forced journey in search of young corn results in the destruction of many of the female moths by birds and other animal enemies and by weather conditions or in failure to find suitable food plants for the young larvæ. A few moths will always succeed in their quest, but the successful proportion will be greatly decreased by persistent crop rotation.

Another remedy, probably the best for this insect, is the thorough destruction, some time before the emergence of the moths in the spring, of all the stalks and stubble remaining in the field from the previous crop. If all this trash can be disposed of at the proper time the moths left to attack the succeeding crop must be reduced greatly, if not altogether exterminated, for the caterpillar is the only form of the insect that passes the winter and the only known location is the tip of the corn taproot. Since it is possible, however, that a few may be able to survive the rigors of winter in the roots of the larger grasses mentioned above, care should be taken to treat these in the same way.

The method employed to dispose of the stalks and stubble will depend largely on conditions in individual cases. If the stubble is cut low and the land is moderately heavy, a thorough deep plowing may suffice, for an inch or two of well settled soil is sufficient to prevent the escape of the moths. Bringing the stubble to the surface where it can dry and be exposed to all the variations of temperature during the winter will kill many of the contained larvæ, but this method depends too much on the state of the weather to be entirely effective. By far the most effective plan is to remove the stubble from the field with a rake and burn it.

ANY method which will insure the complete destruction of the overwintering larvæ, especially if undertaken simultaneously by all the farmers of a locality, will decrease and practically eliminate injury from this insect.

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Larger Corn Stalk-borer. (Farmers' Bulletin 1025.)
Western Corn Rootworm. (Department Bulletin 8.)
Wireworms Attacking Cereal and Forage Crops. (Department Bulletin 156.)
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Desert Corn Flea-beetle. (Department Bulletin 436.)

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Slender Seed-corn Groundbeetle. (Entomology Bulletin 85, Part 2.) Price, 5 cents.
Contributions to Knowledge of Corn Root-aphis. (Entomology Bulletin 85, Part 6.) Price, 5 cents.
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